



## VERIFICATION OF TRANSLATION

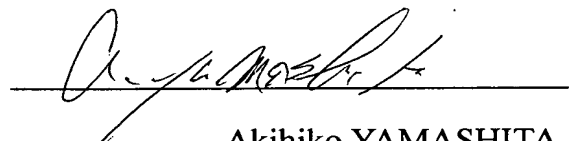
I, Akihiko YAMASHITA of 3rd Floor, Oak Building Kyobashi, 16-10,  
Kyobashi 1-chome, Chuou-ku, Tokyo, 104-0031 Japan, declare as follows:

1. That I am well acquainted with both English and Japanese languages,  
and

2. That the attached document is a true and correct translation made by  
me to the best of my knowledge and belief of:

The specification accompanying the Application No. 2002-249604 for a  
Patent made in Japan filed on August 28, 2002.

October 9, 2008

  
Akihiko YAMASHITA

(No witness required)



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[Document Title] SPECIFICATION

[Title of the Invention] METHOD FOR MANUFACTURING CONDUCTIVE  
PATTERN FORMING BODY

[Patent Claims]

[Claim 1] A method for manufacturing a conductive pattern  
forming body comprising:

a pattern forming body substrate preparing process of  
preparing pattern forming body substrate comprising a base  
material, and a photocatalyst containing layer formed on the  
base material comprising a photocatalyst and a binder whose  
wettability of an energy irradiated part is changed so as a  
contact angle to a liquid is reduced;

a wettability pattern forming process of forming  
wettability pattern comprising a liquid repellent area and a  
lyophilic area on the photocatalyst containing layer by  
irradiating the photocatalyst containing layer in a pattern with  
energy;

a metal colloid coating process of adhering a metal  
colloid only to the lyophilic area of the surface of the  
photocatalyst containing layer on which the wettability pattern  
is formed, by coating the metal colloid; and

a conductive pattern forming process of forming  
conductive pattern by solidifying the metal colloid adhered to  
the lyophilic area of the wettability pattern.

[Claim 2] The method for manufacturing a conductive pattern  
forming body according to claim 1 wherein the photocatalyst  
containing layer contains a decomposable material which is  
decomposed by an action of the photocatalyst by energy  
irradiation whereby the wettability of the photocatalyst

containing layer can be changed.

[Claim 3] The method for manufacturing a conductive pattern forming body according to claim 1 or 2 wherein the photocatalyst containing layer contains fluorine, and wherein the photocatalyst containing layer is formed such that a fluorine content on a surface of the photocatalyst containing layer is reduced by an action of the photocatalyst when energy is irradiated to the photocatalyst containing layer as compared to that before energy irradiation.

[Claim 4] The method for manufacturing a conductive pattern forming body according to claim 3 wherein the fluorine content contained in the part where the fluorine content is reduced by irradiating the energy is 10 or less when the fluorine content of the non-energy irradiated part is defined as 100.

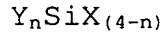
[Claim 5] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 4 wherein the photocatalyst containing layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated.

[Claim 6] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 5 wherein the binder is a layer containing an organopolysiloxane.

[Claim 7] The method for manufacturing a conductive pattern forming body according to claim 6 wherein the organopolysiloxane is a polysiloxane containing a fluoroalkyl group.

[Claim 8] The method for manufacturing a conductive pattern forming body according to claim 6 or 7 wherein the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis

condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3.

[Claim 9] A method for manufacturing a conductive pattern forming body comprising:

a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a wettability variable layer formed on the photocatalyst treatment layer which is a layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced;

a wettability pattern forming process of forming wettability pattern comprising a liquid repellent area and a lyophilic area on the wettability variable layer by irradiating the wettability variable layer in a pattern with energy;

a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the wettability variable layer on which the wettability pattern is formed, by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.

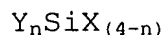
[Claim 10] The method for manufacturing a conductive pattern forming body according to claim 9 wherein the wettability

variable layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated.

[Claim 11] The method for manufacturing a conductive pattern forming body according to claim 9 or 10 wherein the wettability variable layer is a layer containing an organopolysiloxane.

[Claim 12] The method for manufacturing a conductive pattern forming body according to claim 11 wherein the organopolysiloxane is a polysiloxane containing a fluoroalkyl group.

[Claim 13] The method for manufacturing a conductive pattern forming body according to claim 11 or 12 wherein the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3.

[Claim 14] A method for manufacturing a conductive pattern forming body comprising:

a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a decomposition removal layer formed on the photocatalyst treatment layer which is decomposed and removed by an action

of the photocatalyst by energy irradiation;

a decomposition removal pattern forming process of forming a decomposition removal pattern on the decomposition removal layer by irradiating the decomposition removal layer in a pattern with energy;

a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the decomposition removal layer on which the decomposition removal pattern is formed, by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern.

[Claim 15] The method for manufacturing a conductive pattern forming body according to claim 14 wherein a contact angle of a liquid to the decomposition removal layer is different from the contact angle of a liquid to the photocatalyst treatment layer bared by the decomposition of the decomposition removal layer.

[Claim 16] The method for manufacturing a conductive pattern forming body according to claim 14 or 15 wherein the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film and a layer-by-layer self-assembled film.

[Claim 17] The method for manufacturing a conductive pattern forming body according to any one of claims 14 to 16 wherein the decomposition removal layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated.



[Claim 18] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 17 wherein, after the conductive pattern forming process, the method further comprises a non-drawn part removing process of removing a non-conductive pattern part on which a conductive pattern part is not formed.

[Claim 19] The method for manufacturing a conductive pattern forming body according to claim 18 wherein the non-drawn part removing process is a process of removing the non-drawn part by an alkali solution.

[Claim 20] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 19 wherein the photocatalyst is a substance of one or plural types selected from the group consists of titanium oxide ( $\text{TiO}_2$ ), zinc oxide ( $\text{ZnO}$ ), tin oxide ( $\text{SnO}_2$ ), strontium titanate ( $\text{SrTiO}_3$ ), tungsten oxide ( $\text{WO}_3$ ), bismuth oxide ( $\text{Bi}_2\text{O}_3$ ) and iron oxide ( $\text{Fe}_2\text{O}_3$ ).

[Claim 21] The method for manufacturing a conductive pattern forming body according to claim 20 wherein the photocatalyst is titanium oxide ( $\text{TiO}_2$ ).

[Claim 22] The method for manufacturing a conductive pattern forming body according to claim 21 wherein a fluorine element is contained in the surface of the photocatalyst containing layer in a ratio of 500 or more when the content of titanium (Ti) element is defined as 100 at the time of analyzing the content by an X-ray photoelectron spectroscopy to quantitate.

[Claim 23] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 22 wherein the irradiation of energy is conducted while heating the photocatalyst.

[Claim 24] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 23 wherein the metal colloid is a silver colloid or a gold colloid using water as a medium.

[Claim 25] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 24 wherein the coating of the metal colloid in the metal colloid coating process is a dip coating method or a spin coating method.

[Claim 26] The method for manufacturing a conductive pattern forming body according to any of one of claims 1 to 24 wherein the coating of the metal colloid in the metal colloid coating process is a nozzle discharging method.

[Claim 27] The method for manufacturing a conductive pattern forming body according to claim 26 wherein the nozzle discharging method is an ink jet method.

[Claim 28] A conductive pattern forming body comprising: a base material; a photocatalyst containing layer which is a layer formed on the base material whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid in a pattern.

[Claim 29] A conductive pattern forming body comprising: a base material; a photocatalyst containing layer which is a layer formed on the base material in a pattern whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid.

[Claim 30] The conductive pattern forming body according to claim 28 or 29 wherein the photocatalyst containing layer contains a decomposable material which is decomposed by an action of the photocatalyst by energy irradiation and a wettability of the photocatalyst containing layer can be changed by this.

[Claim 31] The method for manufacturing a conductive pattern forming body according to any one of claims 28 to 30 wherein the photocatalyst containing layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated.

[Claim 32] A conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid in a pattern.

[Claim 33] A conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed in a pattern on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.

[Claim 34] A conductive pattern forming body comprising: a

base material; a photocatalyst treatment layer contains at least a photocatalyst, formed in a pattern on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.

[Claim 35] The method for manufacturing a conductive pattern forming body according to any one of claims 32 to 34 wherein the wettability variable layer has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated.

[Claim 36] A conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a decomposition removal layer which is a layer decomposed and removed by an action of the photocatalyst when energy is irradiated, on the photocatalyst treatment layer; and a metal composition formed on the photocatalyst treatment layer which is the decomposition removal layer is decomposed and removed, by solidifying a metal colloid in a pattern.

[Claim 37] The conductive pattern forming body according to claim 36 wherein the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film, and a layer-by-layer self-assembled film.

[Claim 38] The method for manufacturing a conductive pattern forming body according to any one of claims 36 to 37 wherein the decomposition removal layer has a contact angle to the metal

colloid of  $50^\circ$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^\circ$  or less in a part where energy is irradiated.

[0001]

[Field of the Invention]

The present invention relates to a method for manufacturing a conductive pattern forming body which may be used in coatings such as various highly precise electric circuits such as a printed-circuit board.

[0002]

[Prior Art]

Conventionally, when highly precise conductive pattern forming body such as a printed-circuit board is manufactured, a photoresist such as a dry film is laminated on a copper-clad laminate which is formed by plating the entire surface of a substrate with copper, followed by pattern-exposure using a photomask or the like and developing, thereby forming the conductive pattern forming body.

[0003]

However, in such a method using photolithography method, it is necessary to pass through various processes such as plating of a substrate with a metal, formation of a photoresist layer, exposure and developing, making the method for manufacturing complicated and a cost may be a problem. Also, a large amount of waste liquid occurring from developing is harmful, and there is an environmental problem that treatments are necessary to drain these waste liquids outside.

[0004]

Also, there is a method for manufacturing a printed-circuit board by a method using screen printing. However, this method has a problem on precision so that it cannot be applied to the case of manufacturing a highly precise

conductive pattern.

[0005]

[Problem to be Solved by the Invention]

The present invention has been conducted in view of the above problems and it is a main object to provide a method for manufacturing a conductive pattern, which is capable of forming a highly precise pattern by a simple process and being free from such a problem concerning treatment of waste fluids.

[0006]

[Means for Solving the Problem]

In order to achieve the above object, the invention recited in claim 1 provides a method for manufacturing a conductive pattern forming body comprising: a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, and a photocatalyst containing layer formed on the base material comprising a photocatalyst and a binder whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced; a wettability pattern forming process of forming wettability pattern comprising a liquid repellent area and a lyophilic area on the photocatalyst containing layer by irradiating the photocatalyst containing layer in a pattern with energy; a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the photocatalyst containing layer on which the wettability pattern is formed, by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.

[0007]

According to the present invention, the metal colloid can be formed in a pattern on the photocatalyst containing layer with ease by carrying out treatment of adhering the metal colloid to the entire surface by using, for example, a dip coating method, and can be made into a highly precise conductive pattern by solidifying it. As a consequence, since a highly precise conductive pattern can be formed in a simple process with high accuracy, a highly precise conductive pattern can be formed at a low cost.

[0008]

In the invention recited in claim 1, as recited in claim 2, the photocatalyst containing layer may contain a decomposable material which is decomposed by an action of the photocatalyst by energy irradiation whereby the wettability of the photocatalyst containing layer can be changed. In the present invention, although the change in the wettability of the photocatalyst containing layer by the action of the photocatalyst may be caused by a material of the binder, but the wettability of the surface may be changed in a pattern by containing the decomposable material, which is decomposed by an action of the photocatalyst, in this manner in the photocatalyst containing layer.

[0009]

In the invention recited in claim 1 or 2, as recited in claim 3, the photocatalyst containing layer preferably contains fluorine, and wherein the photocatalyst containing layer is formed such that a fluorine content on a surface of the photocatalyst containing layer is reduced by an action of the



photocatalyst when energy is irradiated to the photocatalyst containing layer as compared to that before energy irradiation. Accordingly, it is made possible to have the metal colloid adhere only to the lyophilic area even when the metal colloid is coated entirely.

[0010]

In the invention recited in claim 3, as recited in claim 4, the fluorine content contained in the part where the fluorine content is reduced by irradiating the energy is 10 or less when the fluorine content of the non-energy irradiated part is defined as 100. As the fluorine content in the photocatalyst containing layer is reduced to such degree, difference between the liquid repellent area and the lyophilic area becomes sufficient, and thereby it is made possible to have the metal colloid adhere only to the lyophilic area even when the metal colloid is coated on the entire wettability pattern.

[0011]

In the invention recited in any one of claims 1 to 4, as recited in claim 5, the photocatalyst containing layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated. When the wettability of the liquid repellent area of the photocatalyst containing layer which is the non-energy irradiated part and the wettability of the energy-irradiated part of the photocatalyst containing layer which is the lyophilic area are not within the above-mentioned ranges, it may not possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0012]

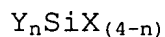
In the invention recited in any one of claims 1 to 5, as recited in claim 6, the binder is preferably a layer containing an organopolysiloxane. This reason is as follows. In the present invention, the properties required for the photocatalyst containing layer are that it has liquid repellency when it is not irradiated with energy, and it is made to be lyophilic by an action of the photocatalyst in the photocatalyst containing layer, which is in contact, when it is irradiated with energy. For a material imparting such properties to the photocatalyst containing layer, it is preferable to use the organopolysiloxane.

[0013]

In the invention recited in claim 6, as recited in claim 7, the organopolysiloxane is preferably a polysiloxane containing a fluoroalkyl group. This reason is that such a polysiloxane containing a fluoroalkyl group can increase a difference in wettability between an energy irradiated part and a non-irradiated part.

[0014]

In the invention recited in claim 6 or 7, as recited in claim 8, the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3. This is because using of such

organopolysiloxanes allows the invention to exhibit the above-mentioned properties against the change in wettability.

[0015]

In the invention recited in claim 9, provided is a method for manufacturing a conductive pattern forming body comprising: a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a wettability variable layer formed on the photocatalyst treatment layer which is a layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced; a wettability pattern forming process of forming wettability pattern comprising a liquid repellent area and a lyophilic area on the wettability variable layer by irradiating the wettability variable layer in a pattern with energy; a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the wettability variable layer on which the wettability pattern is formed, by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.

[0016]

According to the present invention, since the wettability variable layer is provided, the metal colloid can be adhered only to the lyophilic area, and it is therefore possible to form a highly precise conductive pattern. Also, since the conductive pattern is formed on the wettability variable layer, the photocatalyst treatment layer and the conductive pattern

are not in direct contact with each other, and therefore, the possibility of the conductive pattern being affected with time by the photocatalyst is reduced, which makes it possible to produce a high quality conductive pattern forming body.

[0017]

In the invention recited in claim 9, as recited in claim 10, the photocatalyst containing layer preferably has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated. When the wettability of the liquid repellent area of the wettability variable layer which is the non-energy irradiated part and the wettability of the energy-irradiated part of the wettability variable layer which is the lyophilic area are not within the above-mentioned ranges, it may not possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0018]

In the invention recited in claim 9 or 10, as recited in claim 11, it is preferable that the wettability variable layer is a layer containing an organopolysiloxane. In the present invention, the properties required for the wettability variable layer are that it has liquid repellency when it is not irradiated with energy, and it becomes lyophilic when it is irradiated with energy. Therefore, it is preferable to use the organopolysiloxane as a material imparting such properties to the wettability variable layer.

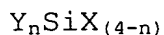
[0019]

In the invention recited in claim 11, as recited in claim

12, the organopolysiloxane is preferably a polysiloxane containing a fluoroalkyl group. This is because such a polysiloxane containing a fluoroalkyl group can increase a difference in wettability between an energy irradiated part and a non-irradiated part.

[0020]

In the invention recited in claim 11 or 12, as recited in claim 13, the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3. This is because using of such organopolysiloxanes allows the invention to exhibit the above-mentioned properties against the change in wettability.

[0021]

The invention recited in claim 14 provides a method for manufacturing a conductive pattern forming body comprising: a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a decomposition removal layer formed on the photocatalyst treatment layer which is decomposed and removed by an action of the photocatalyst by energy irradiation; a decomposition removal pattern forming process of forming a decomposition removal pattern on the decomposition removal layer by irradiating the decomposition

removal layer in a pattern with energy; a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the decomposition removal layer on which the decomposition removal pattern is formed, by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern.

[0022]

According to the present invention, since the decomposition removal layer is provided, an energy irradiated part of the decomposition removal layer is decomposed and removed by an action of the photocatalyst by energy irradiation, the irregularities can be formed on the surface. Utilizing these irregularities, the metal colloid can be coated with ease by, for example, an ink jet method, and therefore, a highly precise conductive pattern forming body can be produced.

[0023]

In the invention recited in claim 14, as recited in claim 15, it is preferable that a contact angle of a liquid to the decomposition removal layer is different from a contact angle of a liquid to the photocatalyst treatment layer bared by the decomposition of the decomposition removal layer. By this, on the decomposition removal layer, a part with the decomposition removal layer remaining, that is not irradiated with energy, can be a liquid repellent area, and a part with bared base material, that is irradiated with energy, can be a lyophilic area. Not only the above irregularities but also a difference in wettability can be utilized, making it possible to produce a highly precise conductive pattern forming body.

[0024]

In the invention recited in claim 14 or 15, as recited in claim 16, it is preferable that the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film and a layer-by-layer self-assembled film. This is because when the decomposition removal layer is the above film, it is possible to form a relatively high strength film with no defects.

[0025]

In the invention recited in any one of claims 14 to 16, as recited in claim 17, the decomposition removal layer has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated. When the contact angle to the metal colloid is not within the above-mentioned range, it may not be possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0026]

In the invention recited in any one of claims 1 to 17, as recited in claim 18, after the conductive pattern forming process, the method may further comprises a non-drawn part removing process of removing a non-conductive pattern part on which a conductive pattern part is not formed. This is because, in a case where the photocatalyst containing layer, wettability variable layer, decomposition removal layer is formed of a conductive material, it is difficult to form a conductive pattern forming body even if the decomposition removal layer is provided with a conductive pattern, a conductive pattern forming body can be made by removing a non-conductive pattern

part on which this conductive pattern part is not formed to bare the insulating base material.

[0027]

In the invention recited in claim 18, as recited in claim 19, the non-drawn part removing process is a process of removing the non-drawn part by an alkali solution. Thereby, it is possible to easily remove the non-drawn part and preferable in terms of production efficiency and production costs.

[0028]

In the invention recited in any one of claims 1 to 19, as recited in claim 20, the photocatalyst is preferably a substance of one or plural types selected from the group consists of titanium oxide ( $\text{TiO}_2$ ), zinc oxide ( $\text{ZnO}$ ), tin oxide ( $\text{SnO}_2$ ), strontium titanate ( $\text{SrTiO}_3$ ), tungsten oxide ( $\text{WO}_3$ ), bismuth oxide ( $\text{Bi}_2\text{O}_3$ ) and iron oxide ( $\text{Fe}_2\text{O}_3$ ). One type or mixtures of two or more types selected from these may be used. In particular, as recited in claim 21, it is preferable that the photocatalyst is titanium oxide ( $\text{TiO}_2$ ). This is because titanium dioxide has high band gap energy, it is effective as a photocatalyst, and also, it is chemically stable without any toxicity, and is easily available.

[0029]

In the invention recited in claim 21, as recited in claim 22, a fluorine element is preferably contained in the surface of the photocatalyst containing layer in a ratio of 500 or more when the content of titanium (Ti) element is defined as 100 at the time of analyzing the content by an X-ray photoelectron spectroscopy to quantitate.

[0030]



The more fluorine element is contained, the higher the liquid repellency of the liquid repellent area becomes, and thereby removal of the metal colloid coated on the entire liquid repellent area becomes easier and it is made possible to coat the metal colloid only to the lyophilic area.

[0031]

In the invention recited in any one of claims 1 to 22, as recited in claim 23, the irradiation of energy is preferably conducted while heating the photocatalyst. By heating the photocatalyst at the time of energy irradiation, the effect of photocatalyst is enhanced and it is possible to effectively form a conductive pattern forming body.

[0032]

In the invention recited in any one of claims 1 to 23, as recited in claim 24, the metal colloid is preferably a silver colloid or a gold colloid using water as a medium.

[0033]

In the invention recited in any one of claims 1 to 24, as recited in claim 25, the coating of the metal colloid in the metal colloid coating process may be a dip coating method or a spin coating method.

[0034]

In the invention recited in any one of claims 1 to 24, as recited in claim 26, the coating of the metal colloid in the metal colloid coating process may be a nozzle discharging method. Among the above, the nozzle discharging method is preferably an ink jet method.

[0035]

The invention recited in claim 28 provides a conductive

pattern forming body comprising: a base material; a photocatalyst containing layer which is a layer formed on the base material whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid in a pattern. According to the present invention, by providing the photocatalyst containing layer, the metal colloid can be coated only to a lyophilic area with ease, and also a highly precise conductive pattern forming body can be formed. Since the present invention comprises the above-mentioned photocatalyst containing layer, the metal colloid can be easily coated only onto the lyophilic area and a highly precise conductive pattern forming body can be made.

[0036]

The invention recited in claim 29 provides a conductive pattern forming body comprising: a base material; a photocatalyst containing layer which is a layer formed on the base material in a pattern whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid. According to the present invention, by providing the photocatalyst containing layer, a conductive pattern can be formed easily by utilizing a difference in wettability, and also, the conductive pattern forming body can be formed at a low cost. Also, since the photocatalyst containing layer is formed in a pattern and the insulating base material is bared in a part other than the

conductive pattern, it is possible to form a conductive pattern forming body even if the photocatalyst containing layer is electrically conductive.

[0037]

In the invention recited in any one of claim 28 or 29, as recited in claim 30, the photocatalyst containing layer may contain a decomposable material which is decomposed by an action of the photocatalyst by energy irradiation and a wettability of the photocatalyst containing layer can be changed by this. In the present invention, although the change in the wettability of the photocatalyst containing layer by the action of the photocatalyst may be caused by a material of the binder, but the wettability of the surface may be changed in a pattern by containing the decomposable material, which is decomposed by an action of the photocatalyst, in the photocatalyst containing layer.

[0038]

In the invention recited in any one of claims 28 to 30, as recited in claim 31, the photocatalyst containing layer has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated. When the wettability of the liquid repellent area of the photocatalyst containing layer which is the non-energy irradiated part and the wettability of the energy-irradiated part of the photocatalyst containing layer which is the lyophilic area are not within the above-mentioned ranges, it may not possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0039]

As recited in claim 32, provided is a conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid in a pattern. According to the present invention, by providing the wettability variable layer, the metal colloid can be adhered easily in a pattern in high precision by utilizing a difference in wettability. Also, since the photocatalyst treatment layer and the conductive pattern are not directly contacted, the possibility of the conductive pattern being affected with time by the photocatalyst is low, which makes it possible to produce a high quality conductive pattern forming body.

[0040]

As recited in claim 33, provided is a conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed in a pattern on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.

[0041]

According to the present invention, by providing the wettability variable layer, the metal colloid can be adhered

easily in a pattern in high precision by utilizing a difference in wettability. Also, since the photocatalyst treatment layer and the conductive pattern are not directly contacted, the possibility of the conductive pattern being affected with time by the photocatalyst is low, which makes it possible to produce a high quality conductive pattern forming body. Further, since the wettability variable layer is formed in a pattern and the relatively insulating photocatalyst treatment layer is bared in a part other than the conductive pattern, it is possible to form a conductive pattern forming body even if the wettability variable layer is electrically conductive.

[0042]

As recited in claim 34, provided is a conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, formed in a pattern on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.[0043]

According to the present invention, by providing the wettability variable layer, the metal colloid can be adhered easily in a pattern in high precision by utilizing a difference in wettability. Also, since the photocatalyst containing layer is formed in a pattern, and the wettability variable layer and the conductive pattern are formed thereon, the relatively insulating base material is bared in a part other than the conductive pattern so that a conductive pattern forming body

can be formed even if the wettability variable layer and the photocatalyst treatment layer are electrically conductive.

[0044]

In the invention recited in any one of claims 32 to 34, as recited in claim 35, the wettability variable layer has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated. When the wettability of the liquid repellent area of the wettability variable layer which is the non-energy irradiated part and the wettability of the energy-irradiated part of the wettability variable layer which is the lyophilic area are not within the above-mentioned ranges, it may not possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0045]

As recited in claim 36, provided is a conductive pattern forming body comprising: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a decomposition removal layer which is a layer decomposed and removed by an action of the photocatalyst when energy is irradiated, on the photocatalyst treatment layer; and a metal composition formed on the photocatalyst treatment layer which is the decomposition removal layer is decomposed and removed, by solidifying a metal colloid in a pattern.

[0046]

According to the present invention, by providing the decomposition removal layer, irregularities can be formed on the surface by an action of the photocatalyst by the above energy

irradiation. The metal colloid can be easily adhered by, for example, an ink jet method and it is therefore possible to make an easily producible conductive pattern forming body.

[0047]

In the invention recited in claim 36, as recited in claim 37, it is preferable that the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film, and a layer-by-layer self-assembled film. This is because when the decomposition removal layer is the above film, it is possible to form a relatively high strength film with no defects.

[0048]

In the invention recited in claim 36 or 37, as recited in claim 38, the decomposition removal layer has a contact angle to the metal colloid of  $50^{\circ}$  or more in a non-energy irradiated part and a contact angle to the metal colloid of  $40^{\circ}$  or less in a part where energy is irradiated. Thereby, not only the above irregularities but also a difference in wettability can be utilized, making it possible to produce a highly precise conductive pattern forming body.

[0049]

[Detailed description of the Invention]

The present invention relates to a method for manufacturing a conductive pattern forming body and to a conductive pattern forming body. Each will be explained hereinbelow.

[0050]

A. Method for manufacturing a conductive pattern forming body

First, the method for manufacturing a conductive pattern forming body according to the present invention will be

explained. In the method for manufacturing a conductive pattern forming body according to the present invention, there are three embodiments. Each embodiment will be hereinafter explained separately.

[0051]

#### 1. First embodiment

First, the first embodiment of the method for manufacturing a conductive pattern forming body according to the present invention will be explained. The first embodiment of the method for manufacturing a conductive pattern forming body according to the present invention comprises:

a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, and a photocatalyst containing layer formed on the base material comprising a photocatalyst and a binder whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced;

a wettability pattern forming process of forming wettability pattern comprising a liquid repellent area and a lyophilic area on the photocatalyst containing layer by irradiating the photocatalyst containing layer in a pattern with energy;

a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the photocatalyst containing layer on which the wettability pattern is formed, by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.



[0052]

In the method for manufacturing a conductive pattern forming body in this embodiment as aforementioned, the photocatalyst containing layer is irradiated in a pattern with energy, whereby the wettability of the surface is changed by an action of the photocatalyst contained in the photocatalyst containing layer. A pattern of the part changed in wettability, that is, a lyophilic area is formed on the surface of the photocatalyst containing layer. Therefore, because after treatments such as developing and cleaning after irradiating energy in the formation of the pattern are not necessary, patterns differing in wettability can be formed by fewer processes and at a lower cost than in conventional cases. Further, by coating the metal colloid to the wettability pattern on the photocatalyst containing layer, the metal colloid can be adhered only to the pattern of the lyophilic area, and by solidifying this, a conductive pattern can be easily formed.

[0053]

Such method for manufacturing a conductive pattern forming body in this embodiment will be explained in detail with reference to the drawings. FIG. 1a to 1d show one example of a method for manufacturing a conductive pattern forming body in this embodiment.

[0054]

In this example, first a pattern forming body substrate 3, comprising a photocatalyst containing layer 2 formed on a base material 1, is prepared (see FIG. 1a, pattern forming body substrate preparing process).

[0055]

Next, as shown in FIG. 1b, a photomask 4 on which a necessary pattern is drawn is placed on the photocatalyst containing layer 2 side of the pattern forming body substrate 3, and a ultraviolet light 5 is irradiated via this photomask 4. By this process, as shown in FIG. 1c, a wettability pattern comprising a lyophilic area 6 and a liquid repellent area 7 is formed on the surface of the photocatalyst containing layer 2 (wettability pattern forming process).

[0056]

Then, a metal colloid is adhered only to the lyophilic area 6 by coating the metal colloid to the entire surface of the above pattern forming body substrate 3 (metal colloid coating process). Thereafter, by curing the metal colloid, a conductive pattern forming body 9 provided with the conductive pattern 8 formed on the photocatalyst containing layer 2 can be obtained.

[0057]

As regards such method for manufacturing a conductive pattern forming body, each process will be explained in detail.

[0058]

#### (1) Pattern forming body substrate preparing process

The pattern forming body substrate preparing process in this embodiment is a process of preparing a pattern forming body substrate comprising a photocatalyst containing layer containing a photocatalyst and a binder is formed on a base material.

[0059]

The pattern forming body substrate manufactured in this process comprises at least a photocatalyst containing layer and

a base material as mentioned above, and is usually manufactured by forming a thin film-like photocatalyst containing layer on a base material by a predetermined method.

[0060]

(Photocatalyst containing layer)

The photocatalyst containing layer used in this embodiment comprises a photocatalyst and a binder, and is a photocatalyst containing layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced.

[0061]

As mentioned above, the wettability of the photocatalyst containing layer is made to be changed so as a contact angle to a liquid is reduced by energy irradiation and pattern irradiation with energy is carried out as will be described later, whereby the wettability can be easily changed in a pattern and it is possible to form a pattern of a lyophilic area having a small contact angle to a liquid. As a consequence, a conductive pattern forming body can be manufactured efficiently and a conductive pattern forming body can be obtained at a low cost.

[0062]

Here, the lyophilic area means an area having a small contact angle to a liquid and having high wettability to a metal colloid which will be described later. On the other hand, the liquid repellent area means an area having a large contact angle to a liquid and having low wettability to the metal colloid.

[0063]

The contact angle of the photocatalyst containing layer to the metal colloid is preferably  $50^{\circ}$  or more, more preferably

60° or more, and particularly preferably 70° or more, in a part where energy is not irradiated, namely the liquid repellent area. This reason is that since the part where energy is not irradiated is a part of which liquid repellency is required in this embodiment, the liquid repellency is not sufficient when the contact angle to a liquid is small. And when the metal colloid is coated on the entire surface in the below mentioned metal colloid coating process, it is not preferable because the metal colloid may be left on the area where the conductive pattern is not formed.

[0064]

Also, the contact angle of the photocatalyst containing layer to the metal colloid is preferably 40° or less, more preferably 30° or less, and particularly preferably 20° or less, in a part where energy is irradiated, namely the lyophilic area. This reason is that in a case where the contact angle to the metal colloid is high in a part where energy is irradiated, namely the lyophilic area, there is the possibility of the metal colloid being repelled even in the lyophilic area when coating the metal colloid on the entire surface and the patterning the lyophilic area with the metal colloid may be difficult.

[0065]

The contact angle to a liquid meant here was obtained in the following manner: the contact angles of the subject material to liquids having different surface tensions were measured (measured 30 seconds after liquid droplets are dripped from a micro-syringe) by a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.) to obtain the contact angle from the results of measurement or a graph

based on these results. In this measurement, wetting index standard solutions manufactured by JUNSEI CHEMICAL CO., LTD. were used as the liquids having different surface tensions.

[0066]

In a case of using the photocatalyst containing layer as aforementioned in this embodiment, the photocatalyst containing layer may be formed such that fluorine is contained in the photocatalyst containing layer, and the fluorine content on the surface of the photocatalyst containing layer is reduced by an action of the photocatalyst when energy is irradiated to the photocatalyst containing layer as compared to that before energy irradiation. Also, the photocatalyst containing layer may be formed such that it contains a decomposable material which can be decomposed by an action of the photocatalyst by energy irradiation to thereby change the wettability of the photocatalyst containing layer.

[0067]

Although the acting mechanism of the photocatalyst represented by the below mentioned titanium dioxide in the photocatalyst containing layer is not necessarily clear, it is considered that carriers generated by irradiation with light effect chemical structures of organic materials by a direct reaction with neighboring compounds or by active oxygen species produced in the presence of oxygen or water. In this embodiment, it is considered that these carriers effect on the binder component in the photocatalyst containing layer to change the wettability of its surface.

[0068]

The photocatalyst, binder and other compositions

constituting the photocatalyst containing layer as aforementioned will be explained hereinbelow.

[0069]

a. Photocatalyst

First, the photocatalyst used in this embodiment will be explained. Examples of the photocatalyst used in this embodiment may include those known as photosemiconductors such as, titanium dioxide ( $\text{TiO}_2$ ), zinc oxide ( $\text{ZnO}$ ), tin oxide ( $\text{SnO}_2$ ), strontium titanate ( $\text{SrTiO}_3$ ), tungsten oxide ( $\text{WO}_3$ ), bismuth oxide ( $\text{Bi}_2\text{O}_3$ ) and iron oxide ( $\text{Fe}_2\text{O}_3$ ). One type or mixtures of two or more types selected from these may be used.

[0070]

In this embodiment, titanium dioxide has a high band gap energy, is chemically stable, free from any toxicity, and easily available, and is therefore, particularly preferably used. There are an anatase type and a rutile type of titanium dioxide. Though the both types may be used in the present invention, an anatase type titanium dioxide is preferable. Anatase type titanium dioxide has an excitation wavelength of 380 nm or less.

[0071]

Examples of anatase type titanium dioxide include anatase type titania sol of hydrochloric acid peptisation type (STS-02 (average particle diameter: 7 nm) manufactured by Ishihara Sangyo Kaisha, Ltd., ST-K01 manufactured by Ishihara Sangyo Kaisha, Ltd.), anatase type titania sol of nitric acid peptisation type (TA-15 (average particle diameter: 12 nm) manufactured by Nissan Chemical Industries, Ltd.), and the like.

[0072]

It is preferable that the particle diameter of the

photocatalyst is smaller because a photocatalytic reaction is run effectively. The average particle diameter is preferably 50 nm or less, and it is particularly preferable to use a photocatalyst of 20 nm or less.

[0073]

The content of the photocatalyst in the photocatalyst containing layer used in this embodiment may be set to be in a range of 5 to 60% by weight and preferably 20 to 40% by weight. Also, the thickness of the photocatalyst containing layer is preferably in a range of 0.05 to 10  $\mu\text{m}$ .

[0074]

#### b. Binder

Next, the binder used in this embodiment will be explained. This embodiment may be divided into three types of configurations: a case where the wettability of the photocatalyst containing layer is changed by an action of the photocatalyst on the binder itself (first configuration), a case where the wettability of the photocatalyst containing layer is changed by compounding a decomposable material, which is decomposed by an action of the photocatalyst by energy irradiation and can change the wettability of the photocatalyst containing layer by this, to the photocatalyst containing layer (second configuration), and a case where these two configurations are combined (third configuration). The binder used in the first configuration and the third configuration must have a function to change the wettability of the photocatalyst containing layer by an action of the photocatalyst, and in the second configuration, such function is not particularly required.

[0075]

Hereinafter, the binder used in the second configuration, that is, first, a binder which function of changing the wettability of the photocatalyst containing layer by an action of the photocatalyst is not particularly required will be explained and next, the binder used in the first configuration and third configuration, that is a binder having a function of changing the wettability of the photocatalyst containing layer by an action of the photocatalyst will be explained.

[0076]

The binder used in the second configuration, which the function of changing the wettability of the photocatalyst containing layer by an action of the photocatalyst is not particularly required, is not particularly limited as long as it has high bonding energy so that its principal skeleton is not decomposed by the photo-excitation of the photocatalyst. Specifically, polysiloxanes having no organic substituent or a few organic substituents can be listed. These polysiloxanes may be obtained by hydrolysis and polymerization condensation of tetramethoxysilane, tetraethoxysilane, or the like.

[0077]

When such a binder is used, it is necessary that a decomposable material, which can be decomposed by an action of the photocatalyst by energy irradiation and can change the wettability of the photocatalyst containing layer by this, is contained to the photocatalyst containing layer as an additive.

[0078]

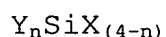
Next, the binder which is used in the first configuration and third configuration, which the function of changing the



wettability of the photocatalyst containing layer by an action of the photocatalyst is required, will be explained. As such a binder, preferable compounds are those having high bonding energy so that their principal skeletons are not decomposed by the photo-excitation of the photocatalyst and having an organic substituent decomposed by an action of the photocatalyst. Examples of these compounds may include (1) organopolysiloxanes which are obtained by hydrolysis and polymerization-condensation of chloro or alkoxy silane or the like by sol-gel reactions and exhibit high strength and (2) organopolysiloxanes obtained by crosslinking reactive silicones which are excellent in water repellency and oil repellency.

[0079]

In a case of the above (1), organopolysiloxanes which are hydrolysis condensates or co-hydrolysis condensates of one kind or two or more kinds of silicon compounds represented by the following formula are preferable.

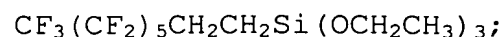
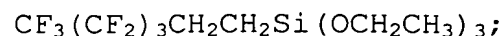
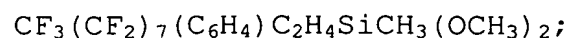
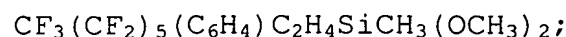
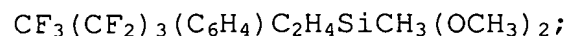
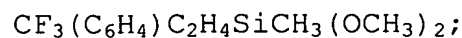
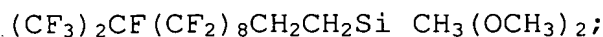
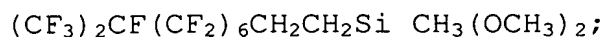
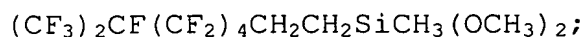
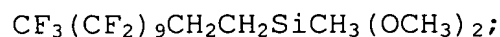
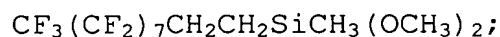
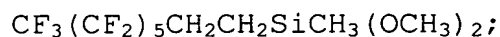
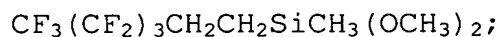
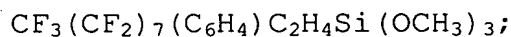
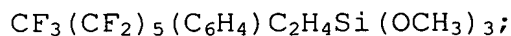
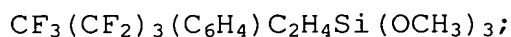
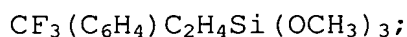
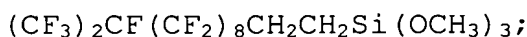
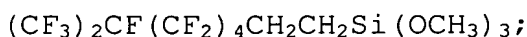
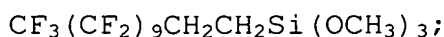
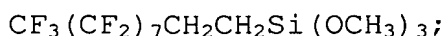
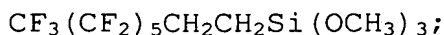
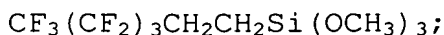


(Wherein Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxy group, an acetyl group or a halogen and "n" denotes an integer from 0 to 3.) Here, the number of carbon atoms in the group represented by Y is preferably in a range of 1 to 20, and the alkoxy group represented by X is preferably a methoxy group, an ethoxy group, a propoxy group or a butoxy group.

[0080]

Also, as the binder, polysiloxanes containing a

fluoroalkyl group are particularly preferably used. Specifically, hydrolysis condensates or co-hydrolysis condensates of one kind or two or more kinds of the following fluoroalkylsilanes can be listed. Those generally known as fluorine type silane coupling agents may be used.



$\text{CF}_3(\text{CF}_2)_7\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3$ ;

$\text{CF}_3(\text{CF}_2)_9\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3$ ;

$\text{CF}_3(\text{CF}_2)_7\text{SO}_2\text{N}(\text{C}_2\text{H}_5)\text{C}_2\text{H}_4\text{CH}_2\text{Si}(\text{OCH}_3)_3$

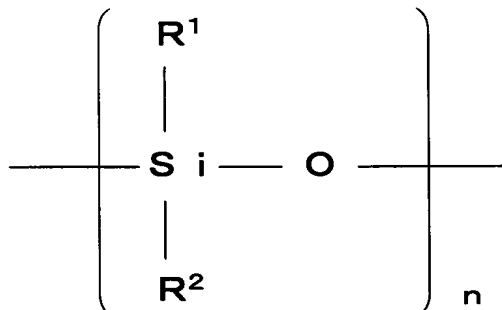
By using the above mentioned polysiloxanes containing a fluoroalkyl group as the binder, the liquid repellency of a non-energy irradiated part of the photocatalyst containing layer is greatly improved and exhibit the function of preventing the adhesion of the metal colloid.

[0081]

Also, as the reactive silicone of the above (2), compounds having a skeleton represented by the following formula can be listed.

[0082]

[Chemical Formula 1]



[0083]

wherein "n" is an integer of 2 or more,  $\text{R}^1$  and  $\text{R}^2$  each represent a substituted or unsubstituted alkyl, alkenyl, aryl or cyanoalkyl group of 1 to 10 carbon atoms; 40% or less by mol ratio to the whole is vinyl, phenyl and phenyl halide. Also,  $\text{R}^1$  and  $\text{R}^2$  are preferably a methyl group because the surface energy is the lowest, and 60% or more by mol ratio is preferably a methyl group. Also, these compounds have at least one reactive group such as a hydroxyl group in a molecular chain at a chain terminal

or side chain.

[0084]

Also, a stable organosilicon compound which does not crosslink, such as a dimethylpolysiloxane, may be compounded in the binder, together with the above organopolysiloxane.

[0085]

(Decomposable material)

In the second configuration and third configuration, it is necessary to further compound a decomposable material, which can be decomposed by an action of the photocatalyst by energy irradiation and can change the wettability of the photocatalyst containing layer by this, in the photocatalyst containing layer. That is, in a case where the binder itself has no function to change the wettability of the photocatalyst containing layer, or in a case where such function is not enough, the above mentioned decomposable material is added to cause a change in the wettability of the photocatalyst containing layer or to help to promote such a change.

[0086]

Examples of such a decomposable material may include surfactants which are decomposed by an action of the photocatalyst and has a function to change the wettability of the surface of the photocatalyst containing layer by being decomposed. Specifically, nonionic surfactants of hydrocarbon types such as each series of NIKKOL BL, BC, BO and BB manufactured by Nikko Chemicals Co., Ltd., fluorine types such as ZONYL FSN and FSO manufactured by Du Pont Kabushiki Kaisha, SURFLON S-141 and 145 manufactured by Asahi Glass Company, MEGAFACE F-141 and 144 manufactured by Dainippon Ink and Chemicals, Incorporated,

FTARGET F-200 and F251 manufactured by NEOS Co., Ltd., UNIDYNE DS-401 and 402 manufactured by DAIKIN INDUSTRIES, LTD., and FLUORAD FC-170 and 176 manufactured by 3M, and silicone type surfactants can be listed. Cationic surfactants, anionic surfactants and amphoteric surfactants may also be used.

[0087]

Besides the surfactants, oligomers and polymers such as a polyvinyl alcohol, unsaturated polyester, acryl resin, polyethylene, diallyl phthalate, ethylenepropylenediene monomer, epoxy resin, phenol resin, polyurethane, melamine resin, polycarbonate, polyvinyl chloride, polyamide, polyimide, styrenebutadiene rubber, chloroprene rubber, polypropylene, polybutylene, polystyrene, polyvinyl acetate, nylon, polyester, polybutadiene, polybenzimidazole, polyacrylonitrile, epichlorohydrin, polysulfide, polyisoprene, and the like can be listed.

[0088]

(Containment of fluorine)

Also, in this embodiment, the photocatalyst containing layer is preferably formed such that the photocatalyst containing layer contains fluorine and the fluorine content in the surface of the photocatalyst containing layer is reduced by an action of the photocatalyst when energy is irradiated to the photocatalyst containing layer, as compared to that before energy irradiation.

[0089]

The photocatalyst containing layer having such properties makes it possible to form a pattern, comprising a part with low fluorine content, with ease by pattern irradiation of energy

as will be described later. Here, fluorine has an extremely low surface energy, and therefore, the surface of a substance containing a lot of fluorine has lower critical surface tension. Therefore, the critical surface tension of the surface of a part having small fluorine content is larger than that of the surface of a part having large fluorine content. This specifically means that the part having small fluorine content is a more lyophilic area than the part having large fluorine content. As a consequence, the formation of a pattern comprising a part having smaller fluorine content than the surrounding surface leads to the result that a pattern comprising a lyophilic area is formed in a liquid repellent area.

[0090]

Therefore, in a case of using such a photocatalyst containing layer, a pattern of lyophilic area can be easily formed in liquid repellent area by pattern irradiation of energy. Therefore, even in a case of coating the metal colloid on the entire surface, the metal colloid can be adhered only to this lyophilic area to make a conductive pattern forming body with ease and therefore, a highly precise conductive pattern can be formed at a low cost.

[0091]

As regards the fluorine content contained in the above mentioned photocatalyst containing layer containing fluorine, the fluorine content of the low fluorine content lyophilic area which is formed by energy irradiation, is preferably 10 or less, more preferably 5 or less, and particularly preferably 1 or less when the fluorine content of the non-energy irradiated part is defined as 100.

[0092]

This is because a large difference in lyophilic properties between an energy irradiated part and a non-energy irradiated part can be caused by setting the fluorine content in the above range. Therefore by forming the conductive pattern on such photocatalyst containing layer, a conductive pattern can be precisely formed only in the lyophilic area where fluorine content is reduced, and the conductive pattern forming body can be obtained with high precision. It is to be noted that the reducing rate is on a weight basis.

[0093]

The fluorine content in the photocatalyst containing layer may be measured by various methods which are generally used. It is not particularly limited as long as it is a method which can measure the quantity of fluorine on the surface quantitatively, for example, an X-ray photoelectron spectroscopy, ESCA (also called Electron Spectroscopy for Chemical Analysis), fluorescent X-ray analysis, and mass spectrometry.

[0094]

In this embodiment, titanium dioxide is preferably used as the photocatalyst as aforementioned. As the fluorine content contained in the photocatalyst containing layer, when titanium dioxide is accordingly used, is as follows when analyzing by an X-ray photoelectron spectroscopy to quantitate. It is desirable that fluorine (F) element is contained in the surface of the photocatalyst containing layer in a ratio of 500 or more, preferably 800 or more, and particularly preferably 1200 or more, when the content of titanium (Ti) element is

defined as 100.

[0095]

This reason is that when fluorine (F) is contained in the photocatalyst containing layer to the above extent, the critical surface tension of the surface of the photocatalyst containing layer can be sufficiently dropped, so that the liquid repellency of the surface can be secured. And this makes it possible to increase a difference in wettability from the surface of the lyophilic area on the pattern part which is reduced in fluorine content by pattern-energy irradiation whereby the precision of the conductive pattern forming body finally obtained can be improved.

[0096]

As to the fluorine content in the lyophilic area formed by pattern energy irradiation in such conductive pattern forming body, a fluorine (F) is preferably contained in a ratio of 50 or less, more preferably 20 or less, and particularly preferably 10 or less, when the content of titanium (Ti) element is defined as 100.

[0097]

If the fluorine content in the photocatalyst containing layer can be reduced to the above extent, lyophilic properties enough to form a conductive pattern can be obtained, which makes it possible to form a conductive pattern with high precision due to a difference in wettability from the liquid repellent area which is the non-energy irradiated part, and a conductive pattern forming body having high utility value can be obtained.

[0098]

c. Method for manufacturing the photocatalyst containing layer



As mentioned above, when the organopolysiloxane is used as the binder, the photocatalyst containing layer may be formed by dispersing the photocatalyst and the organopolysiloxane as the binder together with other additives, as needed, into a solvent to prepare a coating solution, and by coating the coating solution to a base material. As the solvent to be used, an alcohol type organic solvent such as ethanol or isopropanol is preferable. The coating solution may be coated by a known coating method such as a spin coating, spray coating, dip coating, roll coating or beads coating. In a case where an ultraviolet curing type component is contained as the binder, the photocatalyst containing layer may be formed by irradiating ultraviolet rays to carry out curing treatment.

[0099]

(Base material)

In this embodiment, as shown in FIG. 1, a pattern forming body substrate 3 comprises at least a base material 1 and a photocatalyst containing layer 2 formed on the base material 1.

[0100]

In this case, the material constituting the base material to be used is selected properly according to, for example, the direction of energy irradiation in the below mentioned wettability pattern forming process and depending on whether or not the transparency is required to the obtained conductive pattern forming body. That is, when irradiated from the photocatalyst containing layer side, transparency is not required to the base material. However, when energy is irradiated from the base material side, the base material must

be transparent.

[0101]

Also, the base material to be used in this embodiment may be those having flexibility, for example, a resin film, or may be those having no flexibility, for example, a glass substrate.

[0102]

A primer layer may be formed on the base material to improve the adhesion between the surface of the base material and the photocatalyst containing layer. Examples of materials used for the primer layer may include silane type and titan type coupling agents.

[0103]

(Light shielding part)

As the pattern forming body substrate used in this embodiment, a substrate provided with a light shielding part formed in a pattern may be used. In a case where the substrate is provided with such a light shielding part, it is not necessary to use a photomask when the substrate is irradiated with energy and it is also not necessary to carry out laser beam drawing irradiation. Therefore, because the alignment of the pattern forming body substrate with a photomask is not necessary, the process can be simple. Also, because an expensive device required for drawing irradiation is not necessary, there is a merit that it is advantageous in light of cost.

[0104]

As regards the position where the light shielding part is formed, there are a case where the light shielding part is formed on the base material and the photocatalyst containing layer is formed thereon, that is, a case where it is formed in

between the base material and the photocatalyst containing layer, and a case where the light shielding part is formed in a pattern on the surface of the base material on the side which the photocatalyst containing layer is not formed.

[0105]

In either case, energy is irradiated from the base material side. A wettability pattern can be formed in a pattern on the surface of the photocatalyst containing layer by irradiating the entire surface.

[0106]

The method for forming such a light shielding part is not particularly limited, and an appropriate method is selected according to the properties of the surface on which the light shielding part is formed and to required energy shielding properties.

[0107]

For example, a thin film of a metal such as chromium may be formed into a thickness of about 1000 to 2000 Å by a sputtering method or vacuum deposition method, and patterned to form the light shielding part. As this patterning method, usual patterning method such as sputtering may be used.

[0108]

Also, it may be a method in which a layer containing light shielding particles such as a carbon fine particle, metal oxide, inorganic pigment, and organic pigment, in a resin binder is formed in a pattern. As the resin binder to be used, one kind or a mixture of two or more kinds of resins such as a polyimide resin, acryl resin, epoxy resin, polyacrylamide, polyvinyl alcohol, gelatin, casein and cellulose, or photosensitive

resins, further, O/W emulsion type resin compositions, for example, emulsified reactive silicone may be used. The thickness of such resin light shielding part may be set to be in a range of 0.5 to 10  $\mu\text{m}$ . As a method for patterning such a resin light shielding part, usually used methods such as a photolithographic method and printing method may be used.

[0109]

## (2) Wettability pattern forming process

In this embodiment, a wettability pattern forming process is carried out next, wherein the surface of the photocatalyst containing layer is pattern irradiated with energy from a predetermined direction to form a wettability pattern comprising a lyophilic area and a liquid repellent area on the surface of the photocatalyst containing layer.

[0110]

The term "energy irradiation" (exposure) meant in this embodiment is a concept including irradiation with any energy ray capable of changing the wettability of the surface of the photocatalyst containing layer and is not limited to irradiation with visible light.

[0111]

Generally, the wavelength of the light used for the energy irradiation is preferably set in a range of 400 nm or less, more preferably 380 nm or less. This is because the preferable photocatalyst used in the photocatalyst containing layer is titanium dioxide as aforementioned, and light having the above wavelength is preferable as the energy activating a photocatalytic action by this titanium dioxide.

[0112]

Examples of a light source used for the energy irradiation may include a mercury lamp, metal halide lamp, xenon lamp, excimer lamp, and other various light sources.

[0113]

A method in which pattern irradiation via a photomask is carried out by using the above mentioned light sources, or a method in which drawing irradiation is carried out in a pattern by using a laser such as an excimer laser or YAG laser, may be used.

[0114]

The amount of energy to be irradiated when energy is irradiated is set to be the irradiating amount required for changing the wettability of the surface of the photocatalyst containing layer by an action of the photocatalyst contained in the photocatalyst containing layer.

[0115]

In this case, it is possible to raise sensitivity by irradiating energy while heating the photocatalyst containing layer. This is preferable in the point that the wettability can be changed efficiently. Specifically, the photocatalyst containing layer is preferably to be heated at a temperature in a range of 30°C to 80°C.

[0116]

As mentioned above, the direction of energy irradiation in this embodiment, when the base material is transparent, pattern energy irradiation via a photomask or laser drawing irradiation may be carried out from either direction of the base material side or the photocatalyst containing layer side. On the other hand, when the base material is opaque, energy

irradiation must be carried out from the photocatalyst containing layer side, and when the light shielding part is formed, energy irradiation must be carried out from the base material side.

[0117]

### (3) A metal colloid coating process

In this embodiment, a metal colloid coating process is carried out next wherein a metal colloid is coated to the entire surface of the pattern forming body substrate, on which the wettability pattern is formed, to adhere the metal colloid only to a lyophilic area.

[0118]

The coating of the metal colloid is not particularly limited as long as the metal colloid can be coated to the surface of the photocatalyst containing layer. Specifically, it may be methods, such as a dip coating method or spin coating method, in which the entire surface of the property variable layer is coated and methods, such as a nozzle discharging method, in which the metal colloid is coated in an intended pattern. Also, among the nozzle discharging methods, ink jet method is preferable in view of high manufacturing efficiency.

[0119]

The viscosity of the metal colloid used in this embodiment is preferably in a range of 1 to 100 cps, more preferably 5 to 50 cps, and particularly preferably 10 to 20 cps. The concentration is preferably in a range of 1 to 70 wt%, more preferably 10 to 50 wt%, and particularly preferably 20 to 30 wt%. When the viscosity and the concentration are lower than the above range, this is undesirable because the layer thickness

of the resulting metal pattern is too thin and it may be difficult to put it into practical use, though depending on use. On the other hand, when the viscosity and the concentration are higher than the above range, this is undesirable because there is the possibility that patterning cannot be accomplished when such metal colloid is applied to the entire surface.

[0120]

The surface tension of the metal colloid is preferably 20 mN/m or more, more preferably 50 mN/m or more, and particularly preferably 70 mN/m or more. When the surface tension is lower than the above range, this is undesirable because there is the possibility that the contact angle of the liquid repellent area cannot be made to be large with the result that there is the possibility of the metal colloid being left also in the liquid repellent area. Although there is no particular limitation to the upper limit of the surface tension of the metal colloid, the upper limit is preferably 80 mN/m or less.

[0121]

As aforementioned, the metal colloid used in this embodiment is preferably a solution having high surface tension. This reason is that when coated to the entire surface as aforementioned, the metal colloid coated to the liquid repellent area, other than the lyophilic area, must be removed, or concentrated in the lyophilic area. And for this, the contact angle of the liquid repellent area with the metal colloid is preferably large. In this embodiment, a metal colloid using water as a medium is preferably used from this point of view.

[0122]

The type of metal used for the metal colloid in this embodiment is preferably silver or gold. This is because these have good conductivity and corrosion resistance.

[0123]

Therefore, in this embodiment, a gold colloid or silver colloid using water as a medium is preferably used.

[0124]

#### (4) Conductive pattern forming process

In this embodiment, a conductive pattern forming process is finally carried out wherein the metal colloid adhered to the lyophilic area of the photocatalyst containing layer is solidified to make a conductive pattern, thereby finally making the pattern forming body substrate into a conductive pattern forming body.

[0125]

As the solidifying method used here, heating is most general. The metal colloid is heated at temperatures in a range of 100°C to 700°C, and preferably 250°C to 500°C. Heating time is in a range of 10 minutes to 60 minutes and preferably 20 minutes to 40 minutes.

[0126]

#### (5) Non-drawn part removing process

The method for manufacturing a conductive pattern forming body in this embodiment may comprise, other than the above processes, a non-drawn part removing process wherein a non-conductive pattern part where no conductive pattern part is formed is removed. When the aforementioned photocatalyst containing layer is conductive, it is difficult to make a conductive pattern forming body even if a conductive pattern



is provided on the conductive pattern forming body. Therefore, the photocatalyst containing layer of the non-conductive pattern part is removed to bare the base material, thereby making a conductive pattern forming body. In this case, it is necessary that the base material is an insulation material among the aforementioned materials.

[0127]

Here, the conductive pattern part means a part where a conductive pattern, which is formed in the aforementioned conductive pattern forming process, is formed. And the non-conductive pattern part means a part other than the part, where the conductive pattern part is formed on the photocatalyst containing layer, where the photocatalyst containing layer is bared on the surface.

[0128]

The non-drawn part removing process in this embodiment is a process of removing non-drawn part 10 (FIG. 2b) comprising the photocatalyst containing layer bared on the surface of an area other than the conductive pattern 8 area of the pattern forming body substrate (FIG. 2a) formed in the above conductive pattern forming process. The method is not particularly limited as long as the method can remove the non-drawn part 10 and can bare the base material 1.

[0129]

Specific methods for removing this non-drawn part include a method in which an alkali solution or a strong acid such as hydrofluoric acid or concentrated sulfuric acid is coated by a spray or dipped.

[0130]

(6) Others

In this embodiment, the conductive pattern forming body may be subjected to electroplating to increase the layer thickness of the conductive pattern. This is because, by doing so, the resistance of the conductive pattern can be reduced and at the same time, the strength of adhesion of the conductive pattern to the photocatalyst containing layer can be improved, leading to the formation of a high quality and highly precise wiring board.

[0131]

Also, in this embodiment, a protective layer may be formed on the resulting conductive pattern from the viewpoint of, for example, improving the adhesion of the resulting conductive pattern to the base material.

[0132]

2. Second embodiment

Next, the second embodiment of the method for manufacturing a conductive pattern forming body according to the present invention will be explained. The method for manufacturing a conductive pattern forming body in this embodiment comprises:

a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a wettability variable layer formed on the photocatalyst treatment layer which is a layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced;

a wettability pattern forming process of forming

wettability pattern comprising a liquid repellent area and a lyophilic area on the wettability variable layer by irradiating the wettability variable layer in a pattern with energy;

a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the wettability variable layer on which the wettability pattern is formed, by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.

[0133]

As aforementioned, in the method for manufacturing a conductive pattern forming body in this embodiment, a pattern wherein an energy irradiated part is made to be a lyophilic area and a non-energy irradiated part is made to be a liquid repellent area, can be easily formed by irradiating energy in a pattern to the wettability variable layer. The metal colloid can be adhered only to the lyophilic area formed in a pattern and a conductive pattern forming body can be easily formed by solidifying the metal colloid.

[0134]

In the method for manufacturing such a conductive pattern forming body, as shown in FIG. 3 as an example, a photocatalyst treatment layer 11 is formed on a base material 1 (see FIG. 3a). Next, a wettability variable layer 12 is formed on the photocatalyst treating later 11 (see FIG. 3b). A photomask 4 on which a necessary pattern is drawn is placed on the wettability variable layer 12 as shown in FIG. 3c, and ultraviolet light 5 is irradiated via the photomask 4. As shown

in FIG. 3d, a wettability pattern comprising a lyophilic area 6 and a liquid repellent area 7 is thereby formed on the surface of the wettability variable layer 12 (wettability pattern forming process).

[0135]

Next, a metal colloid is coated to the surface of the wettability variable layer 12 to adhere the metal colloid only to the lyophilic area 6 (a metal colloid coating process), and the metal colloid is solidified to form a conductive pattern (see FIG. 3e, conductive pattern forming process).

[0136]

The method for manufacturing a conductive pattern forming body in this embodiment will be hereinafter explained by each process.

[0137]

#### (1) Pattern forming body substrate preparing process

First, a pattern forming body substrate preparing process in this embodiment will be explained. The pattern forming body substrate preparing process in this embodiment is a process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material which contains at least a photocatalyst, and a wettability variable layer formed on the photocatalyst treatment layer which is a layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced. Each configuration will be explained hereinbelow.

[0138]

(Photocatalyst treatment layer)

The photocatalyst treatment layer in this embodiment

contains at least a photocatalyst. When the photocatalyst treatment layer contains a binder, it is the same as the photocatalyst containing layer explained in the first embodiment, therefore, explanations is omitted here. In the second embodiment, however, the wettability of the photocatalyst treatment layer is not necessary changed. Therefore, even in a case where a change in wettability by an action of the photocatalyst on the binder itself is not caused, it is not necessary to compound any decomposable material in the photocatalyst treatment layer like the case of the first embodiment. Also, the method for manufacturing the photocatalyst treatment layer, when it contains a binder, is the same as that of the aforementioned first embodiment. Therefore, explanations are omitted.

[0139]

In the meantime, examples of a method for forming the photocatalyst treatment layer in a case of containing no binder may include methods using a vacuum film forming method such as a sputtering method, CVD method, and vacuum deposition method. A photocatalyst treatment layer having an even layer and containing only the photocatalyst can be formed by forming it by a vacuum film forming method. This makes it possible to change the wettability of the wettability variable layer evenly. Also, since the photocatalyst treatment layer is made only of the photocatalyst, it is possible to change the wettability of the wettability variable layer more efficiently than in a case of using the binder.

[0140]

Also, other examples of the method of forming the

photocatalyst treatment layer made only of the photocatalyst include a method in which, when the photocatalyst is titanium dioxide, amorphous titania is formed on a base material and is then phase-changed to crystal titania by baking. The amorphous titania to be used here can be obtained by hydrolysis and dehydration-condensation of an inorganic salt of titanium such as titanium tetrachloride and titanium sulfide, or by hydrolysis and dehydration-condensation of an organic titanium compound, in the presence of an acid, such as tetraethoxytitanium, tetraisopropoxytitanium, tetra-n-propoxytitanium, tetrabutoxytitanium or tetramethoxytitanium. Then, it is denatured into an anatase type titania by baking at 400°C to 500°C, and may be denatured into a rutile type titania by baking at 600°C to 700°C.

[0141]

(Wettability variable layer)

Next, the wettability variable layer will be explained. In this embodiment, it is not necessary to compound the photocatalyst in the wettability variable layer. Therefore, the possibility of the conductive pattern being affected by the photocatalyst with time can be decreased and it is therefore possible to form a high quality conductive pattern forming body.

[0142]

Although there is no particular limitation to the wettability variable layer as long as it is a layer whose wettability is changed by an action of the photocatalyst treatment layer, it is preferable that it is formed of the same material as the binder contained in the photocatalyst treatment layer used in the first embodiment. The material and the method

for forming the wettability variable layer in a case of forming with the same material as the binder contained in the photocatalyst containing layer of the first embodiment are the same as those in the first embodiment, therefore, explanations of them are omitted.

[0143]

In this embodiment, the thickness of the wettability variable layer is preferably in a range of 0.001  $\mu\text{m}$  to 1  $\mu\text{m}$ , and particularly preferably in a range of 0.01 to 0.1  $\mu\text{m}$ , in relation to the rate of change in wettability caused by the photocatalyst.

[0144]

In this embodiment, by the use of the wettability variable layer having the aforementioned components, an energy irradiated part can be made into to a lyophilic area by changing the wettability and can make a large difference in wettability from that of a non-energy irradiated part, by utilizing action of oxidation or decomposition of organic groups or additives which are a part of the above components by an action of the photocatalyst in the neighboring photocatalyst treatment layer. As a consequence, it is possible to form a conductive pattern forming body having high utility value by improving acceptability (lyophilic properties) and repellency (liquid repellency) to the metal colloid.

[0145]

The wettability variable layer in this embodiment preferably has a contact angle to the metal colloid of 50° or more, more preferably 60° or more, and particularly preferably 70° or more, in a non-energy irradiated part, that is, a liquid

repellent area. This is because the non-energy irradiated part, in this embodiment, is the part of which liquid repellency is demanded, liquid repellency is not sufficient when the contact angle to a liquid is small, leading to a possibility that the metal colloid is left even in an area where a conductive pattern is not formed, when the metal colloid is coated to the entire surface in the below mentioned metal colloid coating process, which is undesirable.

[0146]

Also, the wettability variable layer preferably has a contact angle to the metal colloid of 40° or less, more preferably 30° or less, and particularly preferably 20° or less, in a part where energy is irradiated, namely a lyophilic area. This reason is that in a case where the contact angle to the metal colloid is high in a part where energy is irradiated, namely the lyophilic area, there is the possibility of the metal colloid being repelled even in the lyophilic area when coating the metal colloid to the entire surface, and there is the possibility of being difficult to pattern the lyophilic area with the metal colloid.

[0147]

The wettability variable layer may contain the same fluorine as in the same manner as that described in the paragraph "Containment of fluorine" in the explanations of the photocatalyst containing layer in the above first embodiment.

[0148]

## (2) Wettability pattern forming process

Next, a wettability pattern forming process in this embodiment will be explained. The wettability pattern forming



process in this embodiment is a process of forming wettability pattern comprising a lyophilic area and a liquid repellent area on the surface of the aforementioned wettability variable layer by irradiating the wettability variable layer in a pattern with energy from a predetermined direction. The type of energy, the method of irradiating energy and the like in this wettability pattern forming process are the same as those in the wettability pattern forming process in the first embodiment, therefore, explanations are omitted here.

[0149]

### (3) Metal colloid coating process

Next, a metal colloid coating process will be explained. The a metal colloid coating process in this embodiment is a process of adhering a metal colloid only to the lyophilic area among the wettability pattern comprising the lyophilic area and the liquid repellent area which is formed in the wettability pattern forming process.

[0150]

The metal colloid and the coating method in the metal colloid coating process in this embodiment are the same as those in the metal colloid coating process in the first embodiment, therefore, explanations are omitted here.

[0151]

### (4) Conductive pattern forming process

Next, a conductive pattern forming process is carried out wherein the metal colloid adhered only to the wettability pattern-like lyophilic area in the above metal colloid coating process is solidified. The method of solidifying the metal colloid and the like in this conductive pattern forming process

are the same as those in the conductive pattern forming process in the first embodiment, therefore, explanations are omitted here.

[0152]

(5) Non-drawn part removing process

In this embodiment, a non-drawn part removing process, wherein a non-conductive pattern part where no conductive pattern has been formed is removed, may be comprised after the conductive pattern forming process. When the wettability variable layer is conductive, it is difficult to form a conductive pattern forming body even if a conductive pattern is provided. Therefore, the photocatalyst treatment layer is bared by removing the non-conductive pattern part to form a conductive pattern forming body. Also, the non-drawn part removing process in this embodiment may be a process of removing the wettability variable layer and the photocatalyst treatment layer, when the wettability variable layer and the photocatalyst treatment layer are made of conductive materials. Here, the non-conductive pattern part is a part where conductive pattern is not formed on the wettability variable layer, and the wettability variable layer is bared on the surface.

[0153]

The non-drawn part removing process in this embodiment is also the same as the non-drawn part removing process in the first embodiment, therefore, explanations are omitted here.

[0154]

(6) Others

In this embodiment, the conductive pattern forming body may be further subjected to electroplating to increase the layer

thickness of the conductive pattern. By doing so, the resistance of the conductive pattern can be reduced, and at the same time, the strength of adhesion of the conductive pattern to the wettability variable layer can be improved, leading to the formation of a high quality and highly precise wiring board.

[0155]

Also, in this embodiment, a protective layer may be formed on the resulting conductive pattern from the viewpoint of, for example, improving the adhesion of the resulting conductive pattern to the base material.

[0156]

### 3. Third embodiment

Next, a third embodiment of the method for manufacturing a conductive pattern forming body according to the present invention will be explained. The method for manufacturing a conductive pattern forming body in this embodiment comprises:

- a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising

- a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a decomposition removal layer formed on the photocatalyst treatment layer which is decomposed and removed by an action of the photocatalyst by energy irradiation;

- a decomposition removal pattern forming process of forming a decomposition removal pattern on the decomposition removal layer by irradiating the decomposition removal layer in a pattern with energy;

- a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the decomposition removal

layer on which the decomposition removal pattern is formed, by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern.

[0157]

According to the method for manufacturing a conductive pattern forming body in this embodiment, the decomposition removal layer is decomposed and removed in a pattern by an action of the photocatalyst by irradiating the decomposition removal layer in a pattern with energy, so that it is possible to form a pattern having irregularities on the surface. By utilizing these irregularities, the metal colloid can be adhered in a pattern with ease by coating the metal colloid by, for example, an ink jet method. Also, the decomposition removal layer in this embodiment preferably has the properties that a contact angle of the decomposition removal layer to the metal colloid is different from a contact angle of the base material, bared by removing the decomposition removal layer, to the metal colloid. By this, the metal colloid can be adhered in a pattern by utilizing not only the above irregularities but also a difference in wettability.

[0158]

In the method for manufacturing a conductive pattern forming body as aforementioned, as shown in FIG. 4, a photocatalyst treatment layer 11 is formed on a base material 1 (see FIG. 4a). Next, a decomposition removal layer 13 is formed on the photocatalyst treatment layer 11 (see FIG. 4b). A photomask 4 on which a necessary pattern has been drawn is

placed on the decomposition removal layer 13 as shown in FIG. 4c, and an ultraviolet light 5 is irradiated via the photomask 4. By this treatment, the decomposition removal layer 13 is decomposed and removed in a pattern as shown in FIG. 4d, and resulting in the formation of a decomposition removal pattern comprising an area where the decomposition removal layer 13 is remaining and an area where the photocatalyst treatment layer 11 is bared (decomposition removal pattern forming process).  
[0159]

Next, a metal colloid is coated to the area where the photocatalyst treatment layer 11 is bared to adhere the metal colloid only to the above area (metal colloid coating process), and the metal colloid is then solidified to form a conductive pattern 8, thereby forming a conductive pattern forming body 9 (see FIG. 4e, conductive pattern forming process).  
[0160]

As regards the method for manufacturing a conductive pattern forming body in this embodiment, each process will be explained.  
[0161]

#### (1) Pattern forming body substrate preparing process

First, the pattern forming body substrate preparing process in this embodiment will be explained. The pattern forming body substrate preparing process in this embodiment is a process of preparing pattern forming body substrate comprising a base material, a photocatalyst treatment layer formed on the base material containing at least a photocatalyst, and a decomposition removal layer formed on the photocatalyst treatment layer which is decomposed and removed by an action

of a photocatalyst by energy irradiation. Each configuration will be explained hereinbelow.

[0162]

(Photocatalyst treatment layer)

The photocatalyst treatment layer in this embodiment is the same as that explained in the second embodiment, therefore, explanations are omitted here.

[0163]

(Decomposition removal layer)

Next, the decomposition removal layer will be explained. There is no particular limitation to the decomposition removal layer used in this embodiment as long as a part of the decomposition removal layer which is irradiated with energy is decomposed and removed by an action of a photocatalyst contained in the photocatalyst treatment layer when irradiated with energy.

[0164]

As aforementioned, since an energy irradiated part of the decomposition removal layer is decomposed and removed by an action of a photocatalyst, it is possible to form a pattern comprising a part where the decomposition removal layer is present and a part where the decomposition removal layer is not present, that is, a pattern having irregularity, without carrying out a developing process and a cleaning process.

[0165]

Although this decomposition removal layer is removed without carrying out any particular after treatment such as a developing process and cleaning process because it is, for example, oxidizatioally decomposed or vaporized by an action

of the photocatalyst by energy irradiation, a cleaning process and the like may be carried out though depending on the material of the decomposition removal layer.

[0166]

Also, the decomposition removal layer used in this embodiment is preferably not only forms irregularities but also has a higher contact angle to the metal colloid than the surface of the base material. This is because the decomposition removal layer is thereby decomposed and removed, and an area where the base material is bared can be made into a lyophilic area, and an area where the decomposition removal layer remains can be made into a liquid repellent area, enabling the formation of various patterns.

[0167]

Here, the decomposition removal layer, namely, the liquid repellent area in this embodiment preferably has a contact angle to the metal colloid of  $50^\circ$  or more, more preferably  $60^\circ$  or more, and particularly preferably  $70^\circ$  or more. This is because the non-energy irradiated part is the part of which liquid repellency is demanded in this embodiment, and liquid repellency is therefore not sufficient when the contact angle to a liquid is small. That is not preferable that there is the possibility of the metal colloid being left even in an area where a conductive pattern is not formed, when the metal colloid is coated to the entire surface in a metal colloid coating process.

[0168]

Also, the base material, namely, the lyophilic area in this embodiment preferably has a contact angle to the metal colloid of  $40^\circ$  or less, more preferably  $30^\circ$  or less, and

particularly preferably  $20^\circ$  or less. This reason is that in a case where the contact angle to the metal colloid is high in an energy irradiated part, namely the lyophilic area, there is the possibility of the metal colloid being repelled even in the lyophilic area when coating the metal colloid to the entire surface, and there is the possibility of being difficult to pattern the lyophilic area with the metal colloid. Here, the contact angle to a liquid is a value measured by the method explained in the first embodiment.

[0169]

Specific examples of a layer which may be used as the decomposition removal layer in this embodiment may include those made of fluorine type or hydrocarbon type resins having liquid repellency. There is no particular limitation to these fluorine type or hydrocarbon type resins as long as they have liquid repellency. The decomposition removal layer may be formed by dissolving these resins in a solvent and film forming by a usual method such as a spin coating method.

[0170]

Also, in this embodiment, a layer free from any defect can be formed by using a functional thin film, that is, a self-assembled monolayer, Langmuir Blodgett film, or layer-by-layer self-assembled film, therefore, it is preferable to use these film forming methods.

[0171]

Here, a self-assembled monolayer, Langmuir Blodgett film, and layer-by-layer self-assembled film used in this embodiment will be explained in detail.

[0172]



(i) Self-assembled monolayer

The present inventors have no idea of existence of a formal definition of a self-assembled monolayer. However, as an explanatory text for those recognized generally as a self-assembled monolayer, for example, General Remarks by Abraham Ulman, "Formation and Structure of Self-Assembled Monolayers", Chemical Review, 96, 1533-1554 (1996) is excellent. By referring to this General Remarks, the self-assembled monolayer may be said to be a monolayer produced as a result of the adsorption and bonding (self-assembled) of an appropriate molecule to an appropriate base material. Examples of materials having the ability of forming a self-assembled layer include surfactant molecules such as fatty acids, organic silicon molecules such as alkyltrichlorosilanes and alkylalkoxides, organic sulfur molecules such as alkanethiols, and organic phosphoric acid molecules such as alkyl phosphates. The general point in common of the molecular structure is that they have relatively long alkyl chains and functional groups interacting with the surface of a base material are existing at one molecular terminal. The part of the alkyl chain is a source of intermolecular force when molecules are packed two-dimensionally to each other. Of course, the example shown here is the simplest structure, and self-assembled monolayers comprising various molecules such as those having an amino group or a carboxyl group at the other terminal of the molecule, those in which the part of alkylene chain is an oxyethylene chain, fluorocarbon chain, or chain of the combined type of these chains are reported. Also, there are complex type self-assembled monolayers comprising plural sorts of molecules. Also, in

recent years, there is the case where monolayers in which a layer of polymer, such as particle polymers having plural functional groups (one functional group in some cases) those represented by a dendrimer, or straight-chain polymer (with branching structure in some cases), is formed on a base material surface is considered to be self-assembled monolayers (the latter is generically called a polymer brush). In this embodiment, these are included in the self-assembled monolayers, also.

[0173]

(ii) Langmuir Blodgett film

The Langmuir Blodgett film used in this embodiment does not differ greatly in shape from the aforementioned self-assembled monolayer once it is formed on a base material. It may be said that the Langmuir Blodgett film is characterized by its forming method and highly two-dimensional molecular packing properties (high orientation properties and high orderly properties) due to the forming method. That is, the Langmuir Blodgett film forming molecule is generally developed first on a vapor-liquid interface. The developed film is condensed by a trough and transformed into a highly packed condensed film. Actually, this condensed film is transferred to a proper base material when used. These measures outlined here make it possible to form films ranging from a monolayer to a multilayer film comprising desired molecular layers. Also, not only low molecules but also high molecules and colloid particles may be used as film materials. Current examples of which various materials are used are described in detail in General Remarks by MIYASHITA Tokuji, "Prospects for Nano-technologies by Creation of Soft type Nano-devices"

Polymer, Vol 50, September issue, 644-647 (2001).

[0174]

(iii) Layer-by-layer self-assembled film

Layer-by-layer self-assembled film is a layer which is generally formed by adsorbing and binding at least two materials comprising a functional group comprising a positive or negative charge sequentially to a base material to laminate these materials. Ionic polymers (polymer electrolytes) are frequently used as materials in these days because materials having many functional groups have many advantages such that strength and durability of the layer is improved. Also, particles of proteins, metals, oxides or the like having a surface charge, so-called "colloid particles" are also frequently used as film forming materials. Moreover, films utilizing an interaction weaker than ionic bonds such as a hydrogen bonding, coordinate bonding and hydrophobic interaction have also been recently reported. Relatively recent examples of the layer-by-layer self-assembled film are described in detail in General Remarks by Paula T. Hammond, "Recent Explorations in Electrostatic Multilayer Thin Film Assembly" Current Opinion in Colloid & Interface Science, 4, 430-442 (2000) though slightly inclined towards materials using electrostatic interaction as driving force. The Layer-by-layer self-assembled film is a film formed by repeating a cycle of adsorption of a material having a positive (negative) charge - cleaning - adsorption of a material having a negative (positive) charge - cleaning, for predetermined times, if explained by the simplest process as an example. Unlike the Langmuir Blodgett film, the development - condensation -

transfer operation is not necessary at all. As is clear from the difference between these methods for manufacturing, the layer-layer-self-assembled film is not generally provided with two-dimensional high orientation properties and high orderly properties like the Langmuir Blodgett film. However, the layer-by-layer self-assembled film and its method for manufacturing have many advantages that are not found in conventional film forming methods in the point that an elaborate film free from defects can be easily formed, and the layer-by-layer self-assembled film can be formed evenly on a fine irregular surface, inside surface of a tube, spherical surface and the like.

[0175]

Also, there is no particular limitation to the layer thickness of the decomposition removal layer as long as it is such a level as to be decomposed and removed by irradiated energy in an energy irradiating process which will be described later. Specifically, the thickness is preferably set in a range generally of 0.001  $\mu\text{m}$  to 1  $\mu\text{m}$ , and particularly from 0.01  $\mu\text{m}$  to 0.1  $\mu\text{m}$ , though it differs greatly depending on the type of energy to be irradiated and the material used for the decomposition removal layer.

[0176]

## (2) Decomposition removal pattern forming process

Next, a decomposition removal pattern forming process in this embodiment will be explained. The decomposition removal pattern forming process in this embodiment is a process of forming a pattern, of which the decomposition removal layer is decomposed and removed, on the surface of the decomposition

removal layer by irradiating the decomposition removal layer in pattern with energy from a predetermined direction. The type of energy, the method of irradiating energy and the like in this decomposition removal pattern forming process are the same as those in the wettability pattern forming process described in the first embodiment, therefore, explanations are omitted here.

[0177]

(3) A metal colloid coating process.

Next, a metal colloid coating process will be explained. A metal colloid coating process in this embodiment is a process of adhering a metal colloid to the decomposition removal pattern formed in the above mentioned decomposition removal pattern forming process.

[0178]

The metal colloid and the coating method in the metal colloid coating process in this embodiment are the same as those in the metal colloid coating process in the first embodiment, therefore, explanations are omitted here.

[0179]

When the difference between the contact angle of the decomposition removal layer to the metal colloid and the contact angle of the photocatalyst treatment layer to the metal colloid is small, the metal colloid coating process is preferably carried out by a method of coating the metal colloid in a pattern such as a nozzle discharging method.

[0180]

(4) Conductive pattern forming process

Next, the conductive pattern forming process is carried out wherein the metal colloid adhered in a pattern in the above

a metal colloid coating process is solidified. The method of solidifying the metal colloid in this conductive pattern forming process and the like are the same as those in the conductive pattern forming process in the first embodiment, therefore, explanations are omitted here.

[0181]

(5) Non-drawn part removing process

In this embodiment, the non-drawn part removing process, wherein a non-conductive pattern part where no conductive pattern has been formed is removed, may be comprised after the conductive pattern forming process. When the decomposition removal layer is conductive, it is difficult to make a conductive pattern forming body even if a conductive pattern is provided. Therefore, the photocatalyst treatment layer is bared by removing the remained decomposition removal layer to form a conductive pattern forming body. Also, the non-drawn part removing process in this embodiment may be a process of removing the decomposition removal layer and the photocatalyst treatment layer when the decomposition removal layer and the photocatalyst treatment layer are made of conductive materials.

[0182]

The non-drawn part removing process in this embodiment is also the same as the non-drawn part removing process in the aforementioned first embodiment, therefore, explanations are omitted here.

[0183]

(6) Others

In this embodiment, the conductive pattern forming body may be further subjected to electroplating to increase the layer

thickness of the conductive pattern. By doing so, the resistance of the conductive pattern can be reduced, and at the same time, the strength of adhesion of the conductive pattern to the photocatalyst treatment layer can be improved, leading to the formation of a high quality and highly precise wiring board.

[0184]

Also, in this embodiment, a protective layer may be formed on the resulting conductive pattern from the viewpoint of, for example, improving the adhesion of the resulting conductive pattern to the photocatalyst treatment layer.

[0185]

#### B. Pattern forming body

Next, the pattern forming body of the present invention will be explained. The pattern forming body of the present invention has six embodiments. Each pattern forming body will be explained hereinbelow.

[0186]

##### 1. First embodiment

First, the first embodiment of the pattern forming body of the present invention will be explained. The first embodiment of the pattern forming body of the present invention comprises: a base material; a photocatalyst containing layer which is a layer formed on the base material whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid in a pattern.

[0187]

The conductive pattern forming body in this embodiment is provided with the photocatalyst containing layer, and it is therefore, possible to form a conductive pattern with ease in a small number of processes by utilizing a difference in wettability, and a conductive pattern forming body can be formed at a low cost.

[0188]

Also, in a case of this embodiment, the electric resistance of the photocatalyst containing layer is preferably in a range of  $1 \times 10^8 \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , since the conductive pattern is formed on the photocatalyst containing layer, and it is thereby possible to form an excellent conductive pattern forming body.

[0189]

As aforementioned, the conductive pattern forming body of this embodiment comprises, as shown in FIG. 5 for example, a base material 1, a photocatalyst containing layer 2 formed on this base material 1, and a conductive pattern 8 formed in a pattern on this photocatalyst containing layer 2.

[0190]

As the photocatalyst containing layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the first embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0191]

## 2. Second embodiment



Next, the second embodiment of the conductive pattern forming body of the present invention will be explained. The second embodiment of the conductive pattern forming body of the present invention comprises: a base material; a photocatalyst containing layer which is a layer formed on the base material in a pattern whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, and contains at least a photocatalyst and a binder; and a metal composition formed on the photocatalyst containing layer by solidifying a metal colloid.

[0192]

The conductive pattern forming body of this embodiment is provided with the photocatalyst containing layer, and it is therefore, possible to form a conductive pattern with ease by utilizing a difference in wettability, and also a conductive pattern forming body can be formed at a low cost. Also, in this embodiment, since the photocatalyst containing layer is formed in a pattern, the base material is bared in a part where no conductive pattern is formed. By this, it is possible to form a conductive pattern forming body even if the photocatalyst containing layer is relatively conductive. Also, in this case, the electric resistance of the base material is preferably in a range of  $1 \times 10^8 \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ . This is because it is possible to form an excellent conductive pattern forming body.

[0193]

This embodiment as aforementioned comprises, as shown in FIG. 6 for example, a base material 1, a photocatalyst containing

layer 2 formed in a pattern on this base material 1, and a conductive pattern 8 formed on this photocatalyst containing layer 2.

[0194]

As the photocatalyst containing layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the first embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0195]

### 3. Third embodiment

Next, the third embodiment of the conductive pattern forming body of the present invention will be explained. The third embodiment of the conductive pattern forming body of the present invention comprises: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid in a pattern.

[0196]

The conductive pattern forming body of this embodiment is provided with the wettability variable layer, and it is therefore, possible to adhere the metal colloid in a pattern easily with high precision by utilizing a difference in lyophilic properties. Also, since the photocatalyst treatment layer and the conductive pattern are not directly in contact,

the possibility of the conductive pattern being affected with time by the photocatalyst is reduced, which makes it possible to produce a high quality conductive pattern forming body.

[0197]

Also, since the conductive pattern is formed on the wettability variable layer in this embodiment, the electric resistance of the wettability variable layer is preferably in a range of  $1 \times 10^8 \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ . By this, it is possible to form an excellent conductive pattern forming body.

[0198]

As the aforementioned conductive pattern forming body of this embodiment comprises, as shown in FIG. 12 for example, a base material 1, a photocatalyst treatment layer 11 formed on the base material 1, a wettability variable layer 12 formed on the photocatalyst treatment layer 11, and a conductive pattern 8 formed in a pattern on the wettability variable layer 12.

[0199]

As the photocatalyst treatment layer, wettability variable layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the second embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0200]

#### 4. Fourth embodiment

Next, the fourth embodiment of the conductive pattern forming body of the present invention will be explained. The

conductive pattern forming body of this embodiment comprises: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed in a pattern on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.

[0201]

According to the present embodiment, the wettability variable layer is provided. Therefore, it is possible to adhere the metal colloid in a pattern easily with high precision by utilizing a difference in lyophilic properties. Also, since the photocatalyst treatment layer and the conductive pattern are not directly in contact, the possibility of the conductive pattern being affected with time by the photocatalyst is reduced, which makes it possible to form a high quality conductive pattern forming body.

[0202]

Also, since the wettability variable layer is formed in a pattern in this embodiment, the photocatalyst treatment layer is bared in an area where the conductive pattern is not formed. This makes it possible to form a conductive pattern forming body even in a case where the wettability variable layer is relatively conductive. In this case, the electric resistance of the photocatalyst treatment layer is preferably in a range of  $1 \times 10^8 \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ . By this, it is possible to form an excellent conductive pattern forming body.

[0203]

As the aforementioned conductive pattern forming body of this embodiment comprises, as shown in FIG. 13 for example, a base material 1, a photocatalyst treatment layer 11 formed on the base material 1, a wettability variable layer 12 formed in a pattern on the photocatalyst treatment layer 11, and a conductive pattern 8 formed on this wettability variable layer 12 formed in a pattern.

[0204]

As the photocatalyst treatment layer, wettability variable layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the second embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0205]

## 5. Fifth embodiment

Next, the fifth embodiment of the conductive pattern forming body of the present invention will be explained. The conductive pattern forming body of this embodiment comprises: a base material; a photocatalyst treatment layer contains at least a photocatalyst, formed in a pattern on the base material; a wettability variable layer whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced, formed on the photocatalyst treatment layer; and a metal composition formed on the wettability variable layer by solidifying a metal colloid.

[0206]

According to this embodiment, the wettability variable layer is provided. Therefore, it is possible to adhere the metal colloid in a pattern easily with high precision by utilizing a difference in lyophilic properties. Also, since the photocatalyst treatment layer and the conductive pattern are not in directly contact, the possibility of the conductive pattern being affected with time by the photocatalyst is reduced, which makes it possible to form a high quality conductive pattern forming body. Also, in the conductive pattern forming body of this embodiment, the photocatalyst treatment layer is formed in a pattern on the base material, and the wettability variable layer is formed on this photocatalyst treatment layer. Further, since the conductive pattern is formed on the wettability variable layer, the base material is bared in a part where no conductive pattern is formed. This makes it possible to form a conductive pattern forming body even in a case where the photocatalyst treatment layer and the wettability variable layer are formed of conductive materials. In this case, the electric resistance of the base material is preferably in a range of  $1 \times 10^8 \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega \cdot \text{cm}$  to  $1 \times 10^{18} \Omega \cdot \text{cm}$ . By this, it is possible to form an excellent conductive pattern forming body.

[0207]

As the aforementioned conductive pattern forming body of this embodiment comprises, as shown in FIG. 9 for example, a base material 1, a photocatalyst treatment layer 11 formed in a pattern on this base material 1, a wettability variable layer 12 formed on this photocatalyst treatment layer 11, and a conductive pattern 8 formed on the wettability variable layer

12.

[0208]

As the photocatalyst treatment layer, wettability variable layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the second embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0209]

#### 6. Sixth embodiment

Next, the sixth embodiment of the conductive pattern forming body of the present invention will be explained. The sixth embodiment of the conductive pattern forming body of the present invention comprises: a base material; a photocatalyst treatment layer contains at least a photocatalyst, on the base material; a decomposition removal layer which is a layer decomposed and removed by an action of the photocatalyst when energy is irradiated, on the photocatalyst treatment layer; and a metal composition formed on the photocatalyst treatment layer which is the decomposition removal layer is decomposed and removed, by solidifying a metal colloid in a pattern.

[0210]

The conductive pattern forming body of this embodiment is provided with the decomposition removal layer, and it is therefore possible to adhere the metal colloid in a pattern with ease by utilizing irregularities of the surface by an ink jet method or the like. In the decomposition removal layer in this embodiment, a contact angle to the metal colloid of the

decomposition removal layer preferably differs from a contact angle to the metal colloid of the base material which is bared as a result of the removal of the decomposition removal layer in the contact angle with the metal colloid. This is because, by this, the metal colloid can be adhered in a pattern by utilizing not only the above irregularities, but also a difference in wettability. Therefore, the pattern forming body can be formed with ease.

[0211]

Moreover, in a case of this embodiment, the electric resistance of the photocatalyst treatment layer is preferably in a range of  $1 \times 10^8 \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , since the conductive pattern is formed on the photocatalyst treatment layer.

[0212]

Also, the electric resistance of the decomposition removal layer is preferably in a range of  $1 \times 10^8 \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , and particularly preferably in a range of  $1 \times 10^{12} \Omega\cdot\text{cm}$  to  $1 \times 10^{18} \Omega\cdot\text{cm}$ , since the decomposition removal layer is existing around the conductive pattern. It is thereby possible to form an excellent conductive pattern forming body.

[0213]

In the decomposition removal layer according to this embodiment, as shown in FIG. 10 for example, a photocatalyst treatment layer 11 is formed on the base material 1, a decomposition removal layer 13 is formed on this photocatalyst treatment layer 11, and a conductive pattern 8 is formed on the photocatalyst treatment layer 11 corresponding to the part where



this decomposition removal layer 13 is decomposed and removed.  
[0214]

As the photocatalyst treatment layer, decomposition removal layer, base material, metal colloid, method for forming a conductive pattern, and the like used in this embodiment, those explained in the third embodiment in the aforementioned paragraph "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here.

[0215]

The present invention is not limited to the aforementioned embodiments. These embodiments are examples and whatever has substantially the same structure and produces the same action effect as the technical spirit described in the claim of the present invention is embraced by the technical scope of the present invention.

[0216]

#### EXAMPLES

The present invention will be explained in more detail by way of examples.

[0217]

[Example 1]

0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) which mainly contains a fluoroalkylsilane, 3 g of trimethoxymethylsilane (trade name: TSL8113, manufactured by Toshiba Silicones), and 20 g of STS-01 (trade name, manufactured by Ishihara Sangyo Kaisha, Ltd.) which was a water dispersion of titanium dioxide as a photocatalyst were mixed into 30 g of isopropyl alcohol. The mixture was stirred

at 100°C for 20 minutes to make a photocatalyst containing layer forming composition.

[0218]

The above composition was coated on a blue plate glass by a spin coater and was dried at 120°C for 10 minutes to form a photocatalyst containing layer of 0.2  $\mu\text{m}$  in thickness.

[0219]

The resulting layer was exposed to light (365 nm, 500 mJ/cm<sup>2</sup>) by using a photomask with a 100  $\mu\text{m}$  line & space to form a lyophilic area on the surface of the photocatalyst containing layer.

[0220]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid containing water as a medium (concentration: 20 wt%) was 72°, and the contact angle of the exposed part, that is, the lyophilic area was 9°.

[0221]

The above substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered in a pattern only on the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0222]

[Example 2]

0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) which mainly contains a fluoroalkylsilane, 3 g of trimethoxymethylsilane (trade name: TSL8113,

manufactured by Toshiba Silicones), and 20 g of STS-01 (trade name, manufactured by Ishihara Sangyo Kaisha, Ltd.) which was a water dispersion of titanium dioxide as a photocatalyst were mixed into 30 g of isopropyl alcohol. The mixture was stirred at 100°C for 20 minutes to make a photocatalyst containing layer forming composition.

[0223]

The above composition was coated on a blue plate glass by a spin coater and was dried at 120°C for 10 minutes to form a photocatalyst containing layer of 0.2  $\mu\text{m}$  in thickness.

[0224]

The resulting layer was exposed to light (365 nm, 300  $\text{mJ}/\text{cm}^2$ ) by using a photomask with a 100  $\mu\text{m}$  line & space to form a lyophilic area on the surface of the photocatalyst containing layer.

[0225]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid containing water as a medium (concentration: 20 wt%) was 72°, and the contact angle of the exposed part, that is, the lyophilic area was 30°.

[0226]

The above substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered in a pattern only on the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0227]

[Example 3]

A photocatalyst containing layer was formed and exposed in a pattern to light in the same manner as in Example 1 to form a lyophilic area on the surface of the photocatalyst containing layer.

[0228]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid containing water as a medium (concentration: 50 wt%) was 78°, and the contact angle of the exposed part, that is, the lyophilic area was 11°.

[0229]

The above substrate was dipped in a silver colloid using water as a medium (concentration: 50 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered in a pattern only on the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0230]

[Comparative Example 1]

0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) which mainly contains a fluoroalkylsilane, 3 g of trimethoxymethylsilane (trade name: TSL8113, manufactured by Toshiba Silicones), and 20 g of STS-01 (trade name, manufactured by Ishihara Sangyo Kaisha, Ltd.) which was a water dispersion of titanium dioxide as a photocatalyst were mixed into 30 g of isopropyl alcohol. The mixture was stirred at 100°C for 20 minutes to make a photocatalyst containing layer forming composition.

[0231]

The above composition was coated on a blue plate glass by a spin coater and was dried at 120°C for 10 minutes to form a photocatalyst containing layer of 0.2  $\mu\text{m}$  in thickness.

[0232]

The resulting layer was exposed to light (365 nm, 100 mJ/cm<sup>2</sup>) by using a photomask with a 100  $\mu\text{m}$  line & space to form a lyophilic area on the surface of the photocatalyst containing layer.

[0233]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid containing water as a medium (concentration: 20 wt%) was 72°, and the contact angle of the exposed part, that is, the lyophilic area was 47°.

[0234]

The above substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec. However, the silver colloid was repelled on the entire surface including the lyophilic area, and thus a conductive pattern forming body could not be obtained.

[0235]

[Comparative Example 2]

3 g of trimethoxymethylsilane (trade name: TSL8113, manufactured by Toshiba Silicones), and 20 g of STS-01 (trade name, manufactured by Ishihara Sangyo Kaisha, Ltd.) which was a water dispersion of titanium dioxide as a photocatalyst were mixed into 30 g of isopropyl alcohol. The mixture was stirred at 100°C for 20 minutes to make a photocatalyst containing layer forming composition containing no fluorine.

[0236]

The above composition was coated on a blue plate glass by a spin coater and was dried at 120°C for 10 minutes to form a photocatalyst containing layer of 0.2  $\mu\text{m}$  in thickness.

[0237]

The resulting layer was exposed to light (365 nm, 500 mJ/cm<sup>2</sup>) by using a photomask with a 100  $\mu\text{m}$  line & space to form a lyophilic area on the surface of the photocatalyst containing layer.

[0238]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid containing water as a medium (concentration: 20 wt%) was 45°, and the contact angle of the exposed part, that is, the lyophilic area was 10°.

[0239]

The above substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec. However, the silver colloid was coated on the entire surface including the liquid repellent area, and thus a conductive pattern forming body could not be obtained.

[0240]

[Example 4]

A photocatalyst containing layer was formed in the same manner as in Example 1, and then exposed in a pattern to light. Then, a conductive pattern was formed with a silver colloid using water as a medium to obtain a conductive pattern forming body. Next, the substrate on which the conductive pattern was formed was dipped in an aqueous alkali solution, having a pH of 13 and containing potassium hydroxide as its major component, for 2

minutes and then rinsed with water for five minutes to remove a non-drawn part.

[0241]

[Example 5]

30 g of isopropyl alcohol, 3 g of trimethoxymethylsilane (TSL8113, manufactured by GE Toshiba Silicones Co., Ltd.), and 20 g of ST-K03 (manufactured by Ishihara Sangyo Kaisha, Ltd.) which is a photocatalyst inorganic coating agent, were mixed and was stirred at 100°C for 20 minutes. The mixed solution was diluted with isopropyl alcohol by three times to make a photocatalyst treatment layer composition.

[0242]

The photocatalyst treatment layer composition was coated on a glass substrate by a spin coater, and then dried at 150°C for 10 minutes to form a transparent photocatalyst treatment layer (thickness: 0.15  $\mu\text{m}$ ).

[0243]

Next, 2 g of Iupilon Z400 (manufactured by Mitsubishi Gas Chemical Company, Inc.) containing a polycarbonate as its major component was dissolved into 30 g of dichloromethane and 70 g of 1,1,2-trichloroethane to prepare a decomposition removal layer composition. The decomposition removal layer composition was coated on the photocatalyst treatment layer by a spin coater and dried at 100°C for 60 minutes to form a transparent decomposition removal layer (thickness: 0.01  $\mu\text{m}$ ), thereby obtaining a pattern forming body substrate.

[0244]

Next, the pattern forming body substrate was exposed to light (365 nm, 500 mJ/cm<sup>2</sup>) by a high pressure mercury lamp using

a photomask with a 100  $\mu\text{m}$  line & space to decompose and remove the decomposition removal layer, thereby forming a lyophilic area in a pattern.

[0245]

At this time, each contact angle of the unexposed part and the lyophilic area to a silver colloid using water as a medium (concentration: 20%) was measured (30 seconds after liquid droplets were dripped from a micro-syringe) by using a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.). As a result, the contact each angle was 65° and 6°.

[0246]

Next, a silver colloid using water as its medium (concentration: 20%) was adhered to the lyophilic area by using an ink jet device, and then treated at 300°C for 60 minutes to cure.

[0247]

[Example 6]

30 g of isopropyl alcohol, 3 g of trimethoxymethylsilane (TSL8113, manufactured by GE Toshiba Silicones Co., Ltd.), and 20 g of ST-K03 (manufactured by Ishihara Sangyo Kaisha, Ltd.) which is a photocatalyst inorganic coating agent, were mixed and was stirred at 100°C for 20 minutes. The mixed solution was diluted with isopropyl alcohol by three times to make a photocatalyst treatment layer composition.

[0248]

The photocatalyst treatment layer composition was coated on a glass substrate by a spin coater, and then dried at 150°C for 10 minutes to form a transparent photocatalyst treatment



layer (thickness: 0.15  $\mu\text{m}$ ).

[0249]

Next, 30 g of isopropyl alcohol, 3 g of fluoroalkylsilane (manufactured by GE Toshiba Silicones Co., Ltd.) and tetramethoxysilane (manufactured by GE Toshiba Silicones Co., Ltd.), and 2.5 g of 0.5N hydrochloric acid were mixed and was stirred for 8 hours. The mixed solution was diluted with isopropyl alcohol by 100 times to make a wettability variable layer composition.

[0250]

The wettability variable layer composition was coated on the photocatalyst treatment layer by a spin coater, and then dried at 150°C for 10 minutes to form a transparent wettability variable layer (thickness: 0.1  $\mu\text{m}$ ), thereby obtaining a pattern forming body substrate.

[0251]

Next, the pattern forming body substrate was exposed to light (365 nm, 500 mJ/cm<sup>2</sup>) by a high pressure mercury lamp using a photomask with a 100  $\mu\text{m}$  line & space, thereby forming a lyophilic area in a pattern.

[0252]

At this time, each contact angle of the unexposed part and the lyophilic area to a silver colloid using water as a medium (concentration: 20%) was measured (30 seconds after liquid droplets were dripped from a micro-syringe) by using a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.). As a result, the contact each angle was 80° and 8°.

[0253]

Next, a silver colloid using water as its medium (concentration: 20%) was adhered to the lyophilic area by using an ink jet device, and then treated at 300°C for 60 minutes to cure.

[0254]

Next, the substrate on which the conductive pattern was formed was dipped in an aqueous alkali solution, having a pH of 13 and containing potassium hydroxide as its major component, for 5 minutes and then rinsed with water for 5 minutes to remove a non-drawn part of the wettability variable layer and the photocatalyst treatment layer.

[0255]

[Effect of the Invention]

According to the present invention, the metal colloid can be formed in a pattern on the photocatalyst containing layer with ease by carrying out treatment of adhering the metal colloid to the entire surface by using, for example, a dip coating method, and can be made into a highly precise conductive pattern by solidifying it. As a consequence, since a highly precise conductive pattern can be formed in a simple process with high accuracy, a highly precise conductive pattern can be formed at a low cost.

[Brief Description of the Drawing]

[FIG. 1]

A process diagram showing one example of a method for manufacturing a conductive pattern forming body according to the present invention.

[FIG. 2]

A Process diagram showing one example of a non-drawn part

removing process of a method for manufacturing a conductive pattern forming body according to the present invention.

[FIG. 3]

A process diagrams showing another example of a method for manufacturing a conductive pattern forming body according to the present invention.

[FIG. 4]

A process diagrams showing another example of a method for manufacturing a conductive pattern forming body according to the present invention.

[FIG. 5]

A schematic sectional view showing one example of a conductive pattern forming body according to the present invention.

[FIG. 6]

A schematic sectional view showing another example of a conductive pattern forming body according to the present invention.

[FIG. 7]

A schematic sectional view showing another example of a conductive pattern forming body according to the present invention.

[FIG. 8]

A schematic sectional view showing another example of a conductive pattern forming body according to the present invention.

[FIG. 9]

A schematic sectional view showing another example of a conductive pattern forming body according to the present

invention.

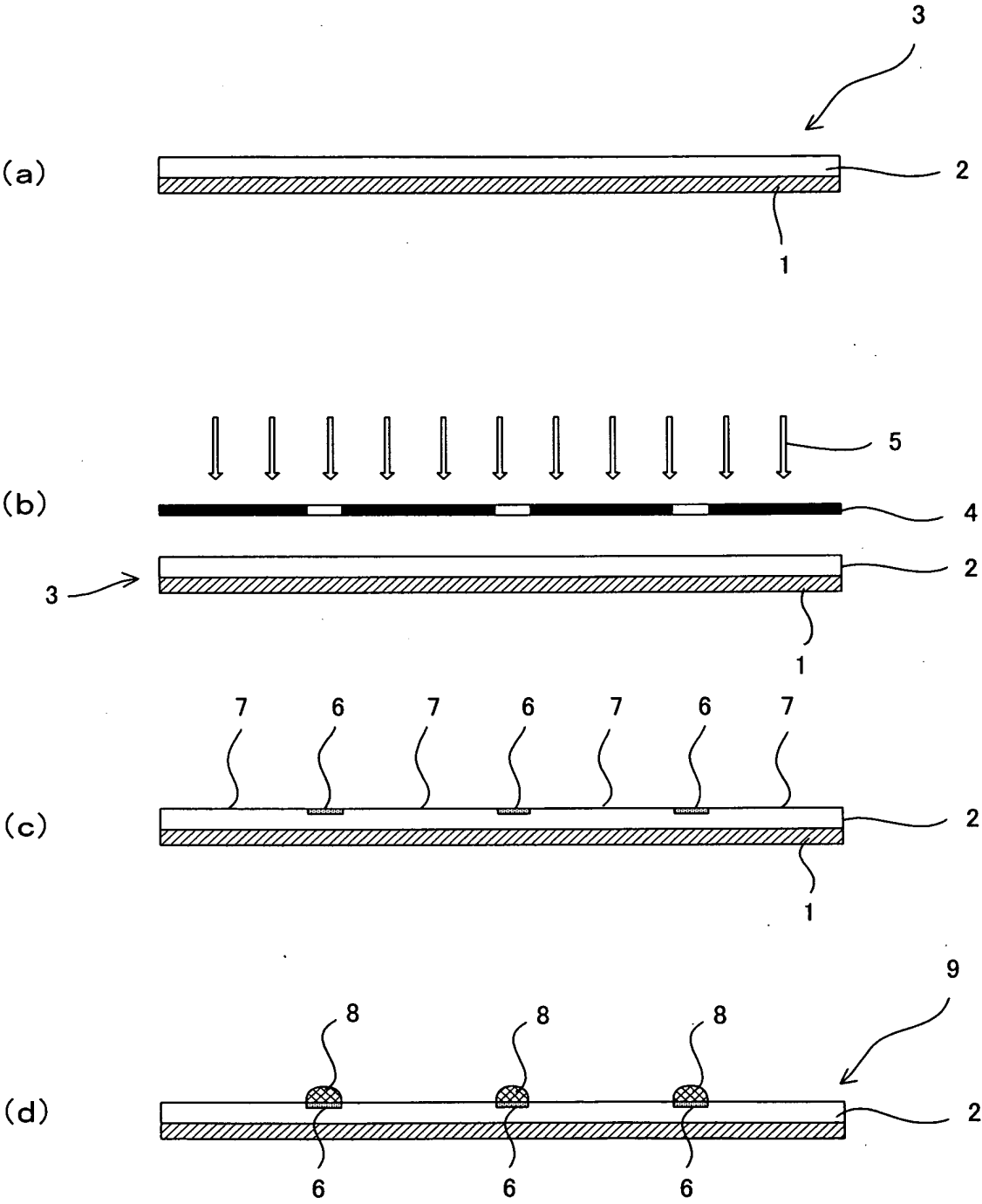
[FIG. 10]

A schematic sectional view showing another example of a conductive pattern forming body according to the present invention.

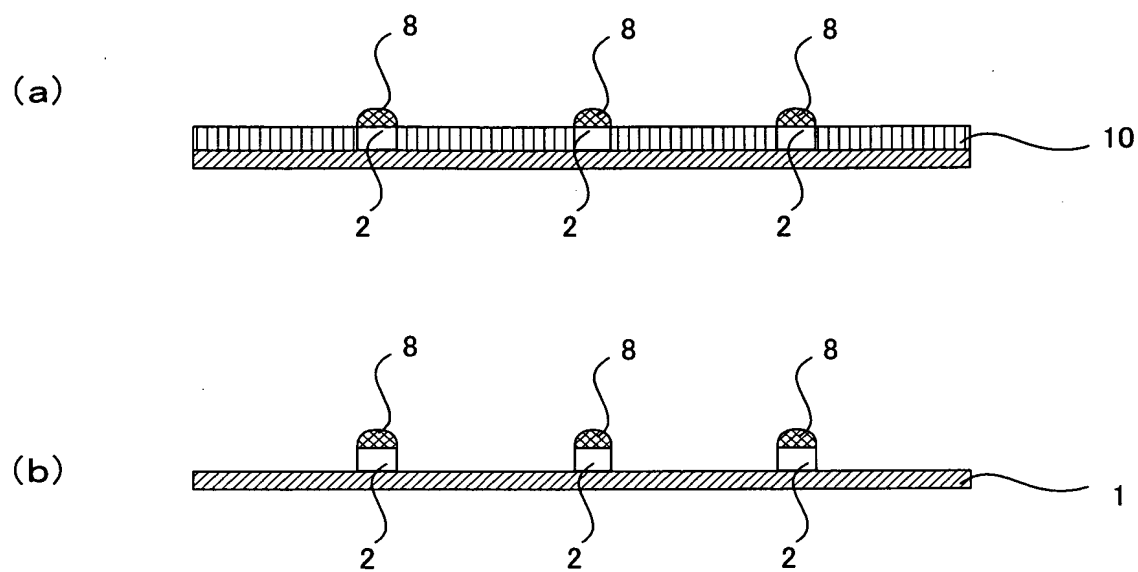
[Description of the reference number]

- 1 Base material
- 2 Photocatalyst containing layer
- 3 Pattern forming body substrate
- 6 Lyophilic area
- 7 Liquid repellent area
- 9 Conductive pattern forming body
- 10 Non-drawn part
- 11 Photocatalyst treatment layer
- 12 Wettability variable layer
- 13 Decomposition removal layer

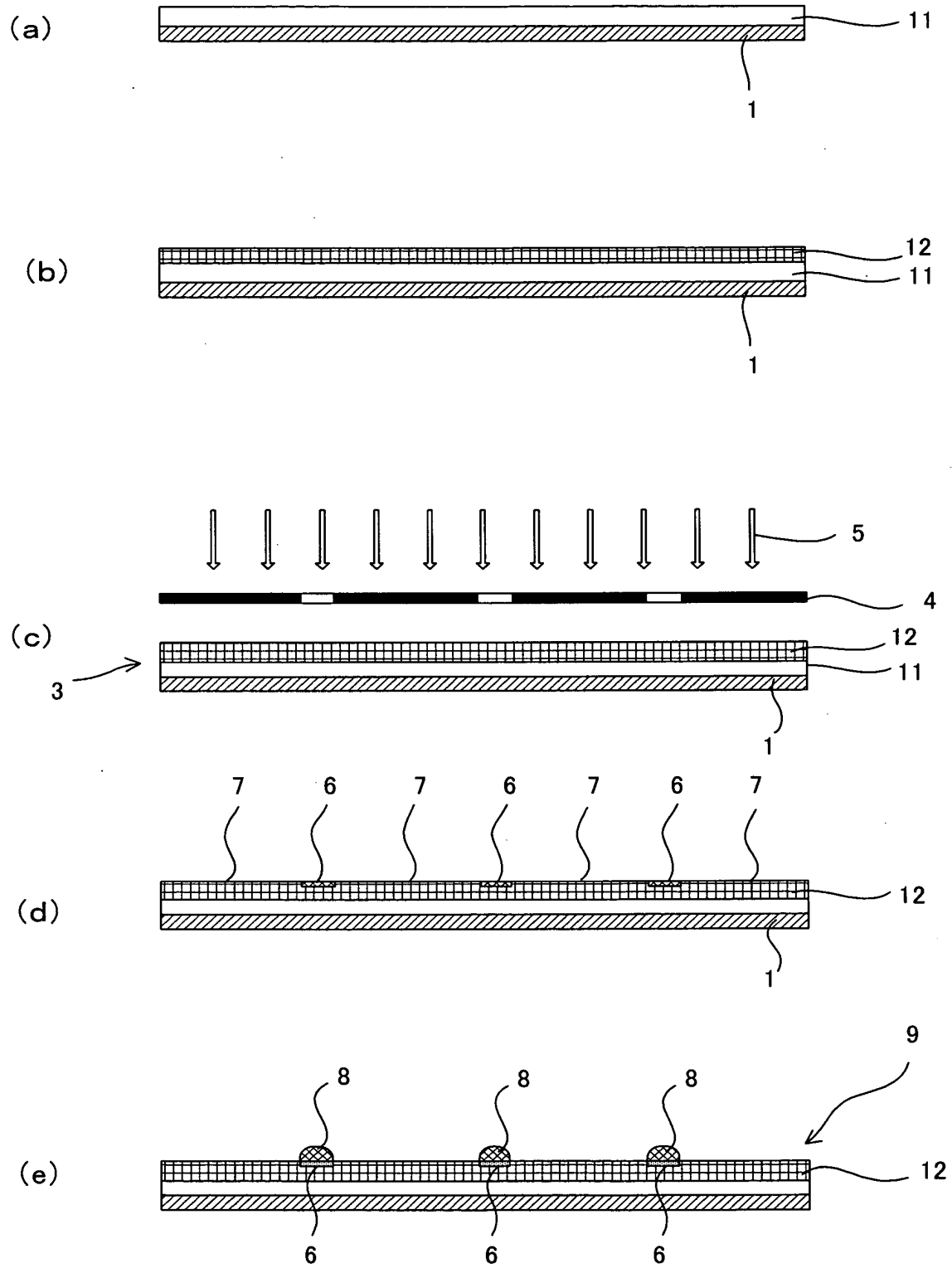
[FIG. 1]



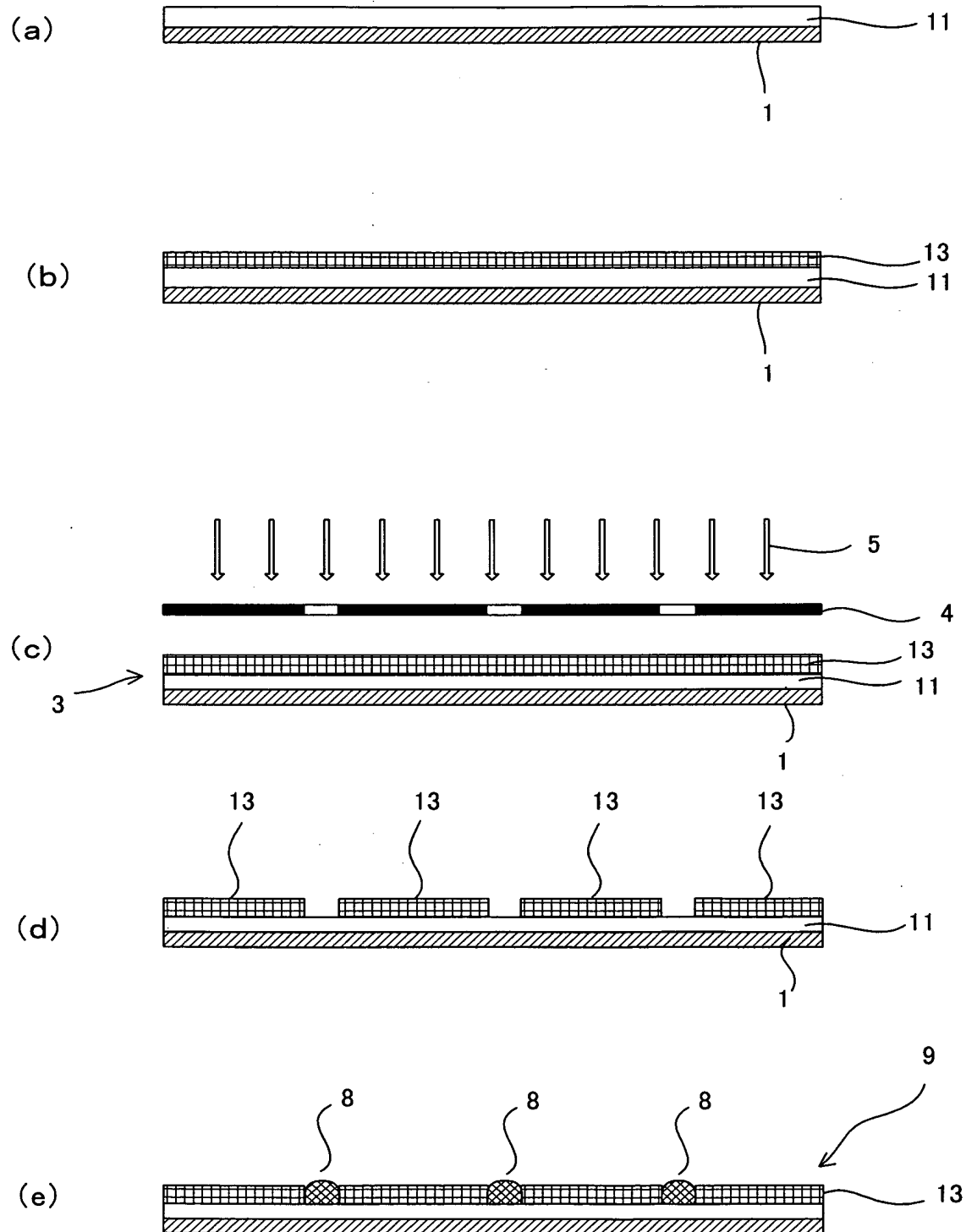
[FIG. 2]



[FIG. 3]

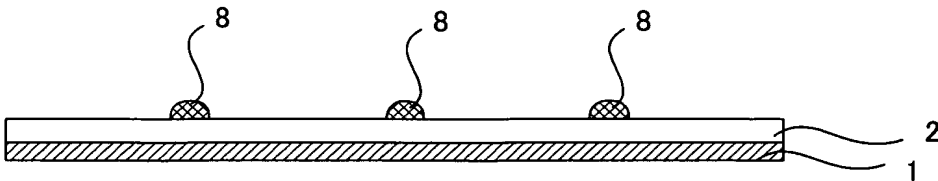


[FIG. 4]

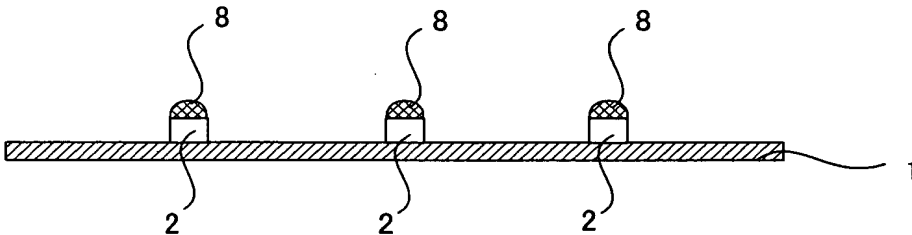




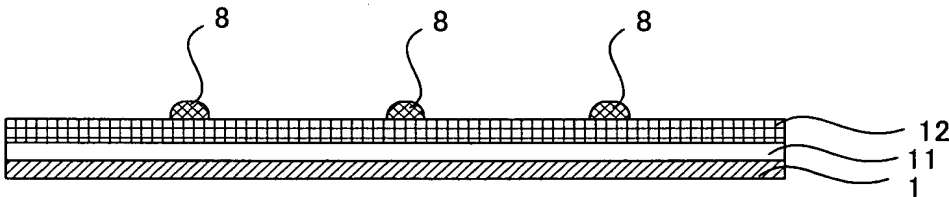
[FIG. 5]



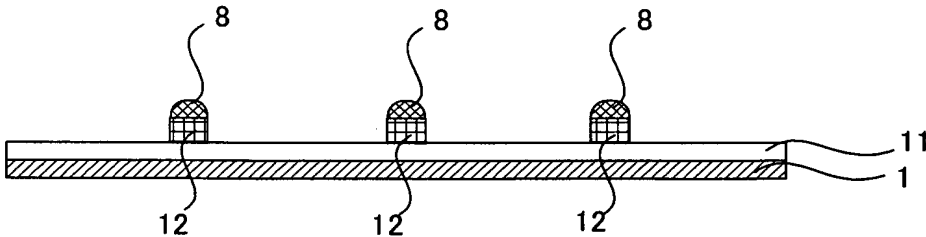
[FIG. 6]



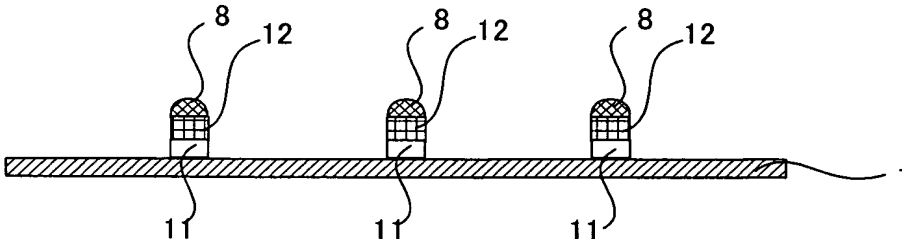
[FIG. 7]



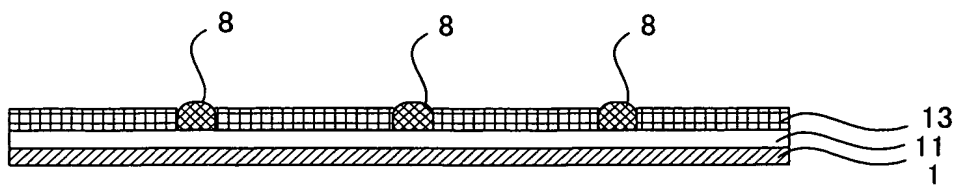
[FIG. 8]



[FIG. 9]



[FIG. 10]





[Document Title]

## ABSTRACT

[Abstract]

[Object] It is a main object of the present invention to provide a method for manufacturing a conductive pattern capable of forming a highly precise pattern, also capable of forming by using a simple process, and being free from problems such as treatment of waste fluids.

[Means of solution] In order to attain the above object, the present invention provides a method for manufacturing a conductive pattern forming body comprising: a pattern forming body substrate preparing process of preparing pattern forming body substrate comprising a base material, and a photocatalyst containing layer formed on the base material comprising a photocatalyst and a binder whose wettability of an energy irradiated part is changed so as a contact angle to a liquid is reduced; a wettability pattern forming process of forming wettability pattern comprising a liquid repellent area and a lyophilic area on the photocatalyst containing layer by irradiating the photocatalyst containing layer in a pattern with energy; a metal colloid coating process of adhering a metal colloid only to the lyophilic area of the surface of the photocatalyst containing layer on which the wettability pattern is formed, by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered to the lyophilic area of the wettability pattern.

[Elected Drawing]

FIG. 1